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palaeotronic

AMAZING SIGHTS OF WONDER AND VISUAL INTRIGUE

CRTing is Believing: How the Cathode Ray Tube put the 'see' in TV

**150
PAGES!**



On Tonight's Program:

**Sarnoff vs. Farnsworth:
the Battle for the Tube**

**Richard Altwasser
talks ZX Spectrum**



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Where would we be now if we hadn't discovered the cathode-ray tube?

I GREW UP WITH THE TUBE FOR A NANNY.

My day would start with Sesame Street, The Great Space Coaster, Reading Rainbow, Mister Rogers... and then later in the afternoon, trashy cartoons such as The Smurfs, He-Man and She-Ra, Scooby Doo and the Flintstones. In black-and-white at first, then colour, the Tube educated, informed and entertained, and frequently suggested what I should be eating for breakfast (which thankfully I never did, thanks Mom!)

During prime-time the family sat around the Tube and played games with Vanna White and Alex Trebek, said good-bye to M*A*S*H, found out who shot JR, saw Hulk Hogan team up with the A-Team to beat the bad guys, and helped fight famine with Band Aid.

The Tube wasn't just for television, either. It also helped me explore the world of early home computing, at first with a Sinclair ZX81, then a Tandy MC-10, a Commodore 64, Atari 130XE, Atari 520ST... and at school Apple IIs and Macintoshes. Oregon Trail and M.U.L.E. and Jumpman and Impossible Mission; Dark Castle, Shufflepuck Cafe, Marble Madness and Stunt Car Racer. Never mind various video-game consoles!

But it wasn't all fun and games – computer programming, word processing and early graphic design (Print Shop and The Newsroom) occupied much of my childhood, as did telecommunicating through bulletin-board systems and navigating early networks such as Tymnet to connect to on-line services such as CompuServe.

It seemed as if I could do anything and go anywhere through the Tube. Televised documentaries took me to ancient Greece and medieval Britain, back to the American Civil War and forward to the 21st century and flying cars (by the way, where's my hoverboard?) Videodiscs and VCRs brought the cinema home, cable television launched 24-hour news and made the music video an art form. Meanwhile, millions used the Tube for work, filling out spreadsheets and calculating complex mathematical formulas, running businesses and making new scientific discoveries. The Tube would provide visual feedback for medical diagnostic and car troubleshooting equipment, act as monitors for closed-circuit security cameras, put the scope in oscilloscope and make critical radar and sonar information immediate and obvious.

The Tube was everywhere, and its influence over western society would only continue to grow toward the end of the 20th century, as multiple-television households, computers and video-game consoles became increasingly more commonplace, until being fully replaced by LCD displays in the early 21st. I can't imagine what the world would have been like without the Tube – or maybe I can.

What if the cathode-ray tube had never been invented? John Logie Baird's mechanical television would've ruled the video airwaves unchallenged – or would it have? Mechanical televisions were finicky, fussy things, and the “flying spot scanner” that acted as a camera by illuminating and broadcasting a scene in progressive little chunks (see Gadget Graveyard for more explanation) only worked in total darkness, making programme production difficult, and was fixed in place, unable to pan, zoom or do anything we expect from a traditional camera. Of course advances in mechanical television would have likely been made, and were – for example, early colour television cameras were actually fancy monochrome “flying spot” scanners with mechanical spinning tinted plastic wheels to record colour. But even these used a really bright CRT to create the light for the scanning spot, replacing large, hot arc lights that made early television studios really uncomfortable places to be.

These issues make it hard to say if mechanical television would have ever taken off. Would the general public have ever seen it as more than just a curiosity, a fancy toy for people with the technical sense to keep their equipment in perfect working order, or would it have evolved into something straightforward enough for adoption by “the common man”? If so, I suspect most television programs would've been filmed on 16mm movie cameras, then “scanned” using some sort of telecine device; perhaps there still would've been *All In The Family* and *Cheers* and *MacGyver* – even in colour, just at 16 frames per second, on a much smaller screen, and with a motor constantly humming in the background. Or would the neighbourhood movie house have survived, with families continuing to make nightly pilgrimages to see the latest newsreels, shorts and features, maybe even well into the 1990s when LCD projectors and panels (presumably) would have eventually, finally launched the “personal screen revolution”?

Alternatively, 8mm film could've become the CRT-free world's videotape, with rental stores providing low-quality reels of movies out of the





cinemas, and current events programmes such as weekly news updates. Either way, while the age of “live” video wouldn’t have happened, I think society would have found a way to survive. After all, immediacy would’ve still been found through radio, or perhaps cable subscription audio programming or “broadcast” telephony.

Computing, however, is another matter entirely. Without video monitors, output would remain constrained to arrays of light-emitting diodes or paper printouts. Could you imagine word processing where you entered and edited your document on paper, to only then output the finished document also on paper? You’d go through an awful lot of ink and dead trees! And I hope you like text adventures, because that’d be the most advanced computer entertainment you’d be likely to get. At least until the world ran out of oxygen after cutting down all the trees just so you could GET LAMP.

Maybe that’s hyperbole – maybe not. The world certainly would have been different though, no argument there. Those medical and automotive diagnostic monitors would’ve beeped and blooped and provided cash register-style printouts instead of video, technicians would’ve needed to learn to identify signals by how they sounded and not how they looked. Security guard would’ve been a popular occupation, with scores of them patrolling stores and public areas, monitoring the populace with eyeballs instead of cameras and video screens.

Or instead of security guards, they may have been government agents – after all, without the Tube to provide immediate feedback for radar systems, World War II could have ended much differently. I don’t know – I don’t have a crystal ball. But I did have the Tube. And while it’s had some poorer moments, it’s hard not to agree that, overall, the Tube was good.

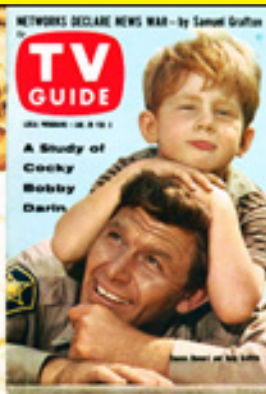
This issue of Paleotronic is a celebration of the Tube – we’ll explore the invention of the Tube, how it won the television war between Baird and a farm boy named Farnsworth, gave birth to the video-game industry, revolutionised computing and so much more. We’ll look at common CRT-related problems and typical repairs, learn the difference between vector and raster graphics, discover how to generate a colour video signal, and find out about obscure applications of the Tube such as slow-scan amateur television. So power up, tune in and turn on, because for this issue the medium really is the message.

All hail the Tube. 🌀



TONIGHT'S PRIME TIME TELEVISION SCHEDULE...

- 0 CHANNEL ZERO - "We begin our broadcast day..."
- 5 **FEATURE PRESENTATION** - "Picture Perfect": A farmboy from Idaho faces off with the King of Radio in the race for television.
- 13 GADGET GRAVEYARD - But before Farnsworth and Sarnoff, Scotsman John Logie Baird explored another way to TV, a mechanical one.
- 21 RADIO WAVES - Getting television signals from here to there.
- 27 POPPED CULTURE - Early science-fiction TV programs - and Tron.
- 31 ENTERTAINMENT CENTRE - Lounge room TVs through the years.
- 35 CRYSTAL BALL - Visions of TV's future from the past.
- 37 ARCADE RATS - Spacewar: From the Laboratory to the Arcade.
- 43 ANCIENT TONGUES - Have a blast playing 2-player Logo Spacewar!
- 47 LOADING READY RUN - The ingenious and quirky ZX Spectrum.
- 50 DIAL-UP CHAT - An interview with the legendary Richard Altwasser.
- 55 PIXEL PLAYAS - No Software Required: Computer Space and Pong.
- 65 THE BARD'S INN - Ultima! Early graphical role-playing games.
- 69 NO CARRIER - BBC Ceefax: the first Teletext information service.
- 73 CHIP TO BE SQUARE - The Noise Channel: The AY-3-8910.
- 75 ELECTRONIC MUSIC - An Australian Story: The Fairlight CMI
- 79 POINT AND CLICK - Welcome to Macintosh: Enter the GUI.
- 83 WOMEN IN TECH - Rosie the Riveter becomes Tracy the TV assembler.
- 85 GEEK UNDERGROUND - PayTV Scrambling: Captain Midnight vs. HBO.
- 89 THE ART SCENE - Prolific Teletext artist Horsenburger talks textart.
- 93 THE TOY STORE - Shooting the TV: Not like Elvis, but with light guns.
- 97 THE ARCHIVIST - Erasing the Tapes: Lost television episodes.





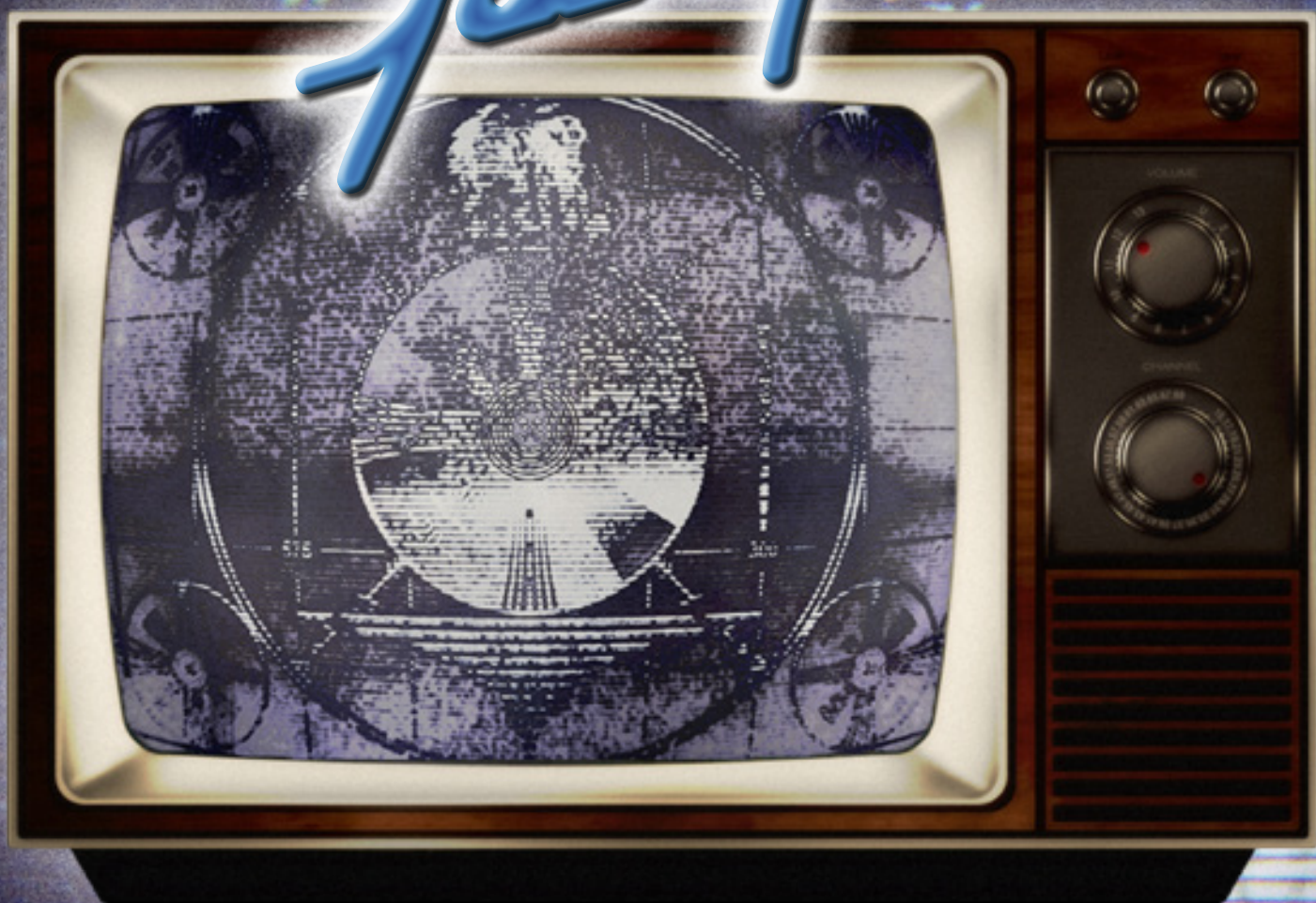
paleoelectronic...A CATHODE RAY TUBE SPECTACULAR!

- 99 COLLECTOR'S CORNER - Danger Will Robinson: Beware the CRT!
- 101 EMULATION STATION - Emulating the Tube: Raster on the LCD.
- 103 HAMATEUR HOUR - Slow Scan TV: Super long-range television.
- 105 HEAVY DUTY - Electronics at War: "C"-ing radar with the CRT.
- 107 ELECTRONS IN MOTION - Cathode-ray tube flight displays.
- 109 THE BUSINESS - Who's Going to Pay? Television advertising.
- 111 THE PRO SHOP - The Cardioscope: Watching the Heart.
- 113 THE BREADBOARD - Pong: or How I Learned to Love Getting Paddled.
- 119 ANDROID DREAMS - The Murder on Channel 4.
- 123 THE DEAD LETTER OFFICE - Computers on the TV.
- 125 FIDOMAIL - An early Apple II advertisement spawns commentary.
- 126 INTERESTING DEVELOPMENTS - OpenEmulator and Applesauce.
- 127 MICROM8 UPDATE - The latest features added to our emulator.
- 129 YESTERDAY'S NEWS - The Oregon Trail handheld game and more.
- 132 RETRO REVIEWS - C64 accessories: uCassette, SD2IEC, 4-player.
- 135 ON THE ROAD - Visiting the Australian Pinball Museum.
- 137 ATTACK OF THE CLONES - FEO HAO Retro Game HD Genesis Clone.
- 139 BACK IN THE DAY - 1977: The first West Coast Computer Faire.
- 141 THANK YOU - Special thanks to all of our generous supporters.
- 143 COMMUNITY CALENDAR - Updates and upcoming events.
- 145 THE BBS LIST - Internet Resources: Chat rooms, Facebook etc.
- 147 THE FUN ZONE - CRT Crossword, Word Search and Comics!
- 149 PARTING SHOT - "This brings to a close another broadcast day.." 📺

TV Guide started in New York City in 1948 as The TeleVision Guide. Over the next five years, similar publications sprung up in other American cities, and in 1953 publisher Triangle Publications bought TV Guide and amalgamated all of the other television guides under that name, taking TV Guide national and publishing it every two weeks since.



PICTURE *perfect*



In the race for
electronic

television

there could
only be one winner

FEATURE PRESENTATION

GLANCING AT HIS MORNING PAPER,
DAVID SARNOFF QUICKLY REALISED
HE HAD A BIG, BIG PROBLEM.

Sarnoff, the president of the Radio Corporation of America (RCA) had spent his entire adult life rising up through the ranks of the American Marconi wireless telegraph company. David was a Russian immigrant who started as a mere office boy in 1906 at the age of 15, learning about electronics and wireless communications on-the-job. He served at Marconi radiotelegraph stations on ships and on shore, soon becoming a manager of the telegraphers, then chief inspector and contract manager. However, David wasn't merely content to ride the radio wave of the present – rather, he was always looking toward the future, even then.

So was an Idaho farmboy named Philo T. Farnsworth.

Learn
**how some forgotten baking
“cracked” the case of the first
viable electronic camera, and
kickstarted the era of television.**

David Sarnoff had already had some pretty big ideas.

The utility of the “wireless” had, to that point, been commonly seen as a point-to-point, two-way technology – you talked to the remote station, and they talked back. You had a conversation, and when you were done, others took your place, like a telephone. But there were the occasional “broadcast” messages, like weather reports, and that combined with news of voice transmission tests piqued Sarnoff’s interest. He wondered if new radio technologies could transmit music with any clarity, and so in 1915 he did a demonstration of his own, from a station in New York, broadcasting music to anyone who could – and wanted to – listen.

David wrote a memo to his superiors proposing the idea of a receiver-only radio set, one that would allow an owner to listen to music broadcasts passively, but his superiors scoffed at the idea and ignored him. Why would they congest the airwaves with rubbish like that, wasting valuable space that could be used for two-way communication? The radio, after all, was going to eventually replace the telephone, wasn’t it? Time went on. After World War I ended, General Electric bought American Marconi, and Sarnoff revived his idea, which once again was discounted. Why would anyone want to listen to an arbitrary sequence of songs over the radio when they could play whatever recordings they wanted? They could go to the music hall for that sort of thing. And newspapers did news – that’s what they were for! David’s “receiver” would never catch on. Going down that road would just waste the company’s time and money.



David Sarnoff at fifteen, working as a messenger boy for Marconi. Sarnoff was born in 1891 near Minsk in present-day Belarus to a Jewish family who emigrated to the United States in 1900. In 1906 his father fell ill with tuberculosis, and David had to go to work to support his family.

But Sarnoff was undeterred. In 1921 he helped to privately organise a “live” broadcast of a heavyweight boxing match between Georges Carpentier and Jack Dempsey and afterward, the public demand for radio receivers was palpable. Having adequately demonstrated an application of radio – live event coverage – that was unavailable to any other medium, David’s bosses at RCA had no choice but to journey with Sarnoff down his rabbit-hole, and in 1925 RCA purchased its first radio station in New York, launching the National Broadcasting Company (NBC) and placing Sarnoff at its helm. He would guide and grow the world’s first radio network for four years, before becoming the president of RCA. However Sarnoff wasn’t content.

David was aware of recent experiments regarding the transmission of moving images. Scottish inventor John Logie Baird had demonstrated the first working “television” (the term coined in 1900 by Russian engineer Konstantin Perskiy – vision meaning “to see” and tele signifying “over a distance”) in 1926, and Sarnoff deduced quite accurately that if the public had gone crazy over being able to hear a boxing match, they would go completely insane if they could actually see it. To say television was on Sarnoff’s radar would be a gross understatement indeed. But Baird’s system was mechanical, low definition and hard to see, and Sarnoff didn’t think it was practical. But eventually it would improve and then he would pounce, using RCA’s might to shut Baird out of the North American market, appropriating the Scotsman’s technology for itself, and taking all the credit (and the profits).

And so, when Sarnoff looked at his newspaper and saw that an American couple, Philo and Pem Farnsworth, had demonstrated not only a working television system but an all-electronic television system using the cathode-ray tube on both the transmission and receiving sides, and without the annoyances of its mechanical cousin – it was quieter, and the screen was brighter and larger – he quickly realised he had a problem. His first instinct was to buy the Farnsworths out, but he soon discovered they had investors – bankers that reportedly owned 60% of their company, and who weren’t going to sell cheaply. RCA hadn’t made its fortunes by being generous to others – in fact, Sarnoff was often accused of being a robber baron, and if he couldn’t get what he wanted one way, he would get it another.

NBC grew so large that in some cities it had more than one station. The US congress eventually forced RCA to sell many of those duplicate stations, which became another network, the American Broadcasting Company (ABC)



Philo T. Farnsworth was born in Utah to Mormon parents. The eldest of five children, Philo developed an interest in electronics after a long-distance telephone call with a relative. He used some junk parts to convert his mother's washing machine from hand-powered into electric, and won US\$25 for inventing a magnetised car lock.

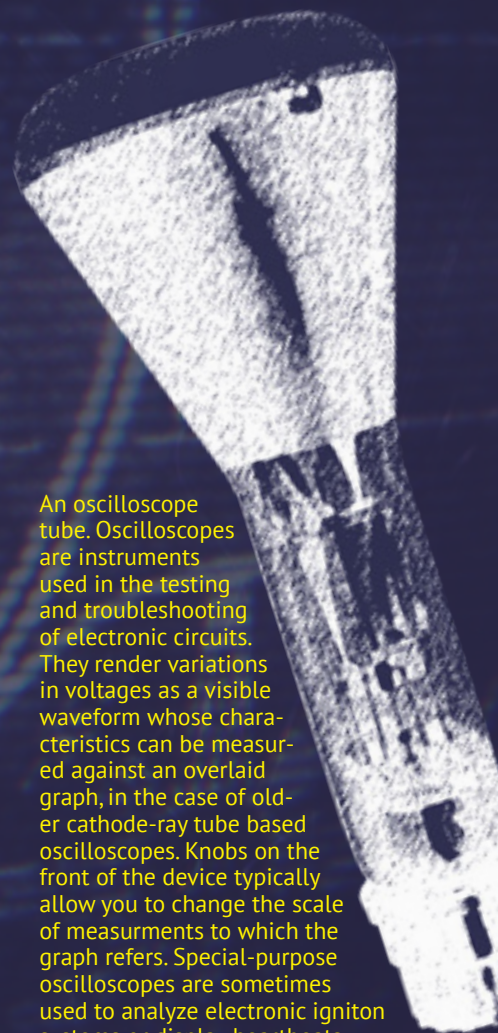
But Philo Farnsworth hadn't had much of a choice. He needed money in order to pursue his invention, and that was the only offer on the table. Investing in television would seem like a no-brainer today, but at its birth it was considered an extremely risky investment – not only had inventors been chasing the dream (and spending money) for over two decades, but they still hadn't adequately answered the question of whether anyone really wanted it enough to pay for it. But Farnsworth was convinced of television's revolutionary potential, and had been ever since 1921, when he was fifteen and had drawn sketches of a proposed fully-electronic television system for his high school science teacher.

Born in 1906 in Utah, Philo T. Farnsworth moved to Rigby Idaho with his family in 1918 on to a relative's 240-acre ranch. The farmhouse had an electric generator, and Philo soon found a cache of technology-related magazines in the attic. He was a quick study, learning how to perform repairs on the generator and fix burnt-out electric motors. But his young mind soon turned to larger problems. Philo began to contemplate the idea of all-electronic television, reportedly having an epiphany regarding the raster scanning (scanning sequentially in rows) process of an image using cathode rays while gazing upon the impressions left in a harvested Idaho wheat field, but the bulk of his proposed system was likely influenced by the work of Scottish engineer Alan Campbell-Swinton, whose extremely similar theoretical system of television Campbell-Swinton had first described in a letter to the British journal *Nature* in 1908, titled "Distant Electric Vision", in which he described a system of two cathode-ray tubes.

Cathode rays were discovered in 1869 by German physicist Johann Hittorf. He had been experimenting with Crookes tubes, a glass bulb enclosing a partial vacuum, with two metal electrodes, one inserted at one end and the other suspended in the tube toward the other. When high-voltage was applied to the first electrode (the cathode), a stream of particles (later named electrons) would bridge across the vacuum to the other electrode (the anode), but more importantly, many would overshoot and "sparkle" as they hit the glass wall of the tube. A bit of fluorescent paint applied to the end of the tube showed that the electrons were travelling in straight lines, and hence the streams were called "cathode rays". After British physicist William Crookes (the inventor of the Crookes tube) demonstrated that the direction of cathode rays could be controlled by magnetic fields (a concept improved upon by Campbell-Swinton), German Ferdinand Braun built the first proper cathode-ray tube in 1897, containing a phosphor-coated screen which he used to build the first oscilloscope, a device for visualising frequencies.

However, the number of electrons striking the screen in the Braun tube were few, and the light output was dim. An American physicist, John B. Johnson, developed a "hot cathode" tube, where the cathode is heated to increase the number of electrons emitted (this heating process is why older CRT-based televisions can sometimes take a few seconds to show a screen), and his tube entered commercial production in 1922, one year after Farnsworth's presentation to his teacher. All-electronic television was now possible, someone only had to work out the details and build it.

Campbell-Swinton's theoretical television system was featured in a 1915 issue of the popular American magazine *Electrical Experimenter*. It is much more likely a young Philo Farnsworth had encountered that article (maybe even in his attic), given the similarities between his system and Campbell-Swinton's, and gained most of his initial inspiration there rather than inventing an entire television process in an Idaho wheat-field on his own, but regardless of where Farnsworth obtained his ideas, he was American; he was first to make it actually work (a remarkable achievement); and, worst of all, he was someone else's property – making David Sarnoff's only remaining advantage the wealth of RCA, which he could leverage with great abandon...and would.



An oscilloscope tube. Oscilloscopes are instruments used in the testing and troubleshooting of electronic circuits. They render variations in voltages as a visible waveform whose characteristics can be measured against an overlaid graph, in the case of older cathode-ray tube based oscilloscopes. Knobs on the front of the device typically allow you to change the scale of measurements to which the graph refers. Special-purpose oscilloscopes are sometimes used to analyze electronic ignition systems or display heartbeats.

The race was on.

Sarnoff met with Vladimir Zworykin, an engineer at American manufacturing company Westinghouse, who had studied in Russia under Boris Rosing, a Saint Petersburg scientist who had been working on television since 1902. Rosing demonstrated the first television of any kind in 1911, and Zworykin graduated the following year in 1912. He moved to the United States toward the end of the Russian Civil War and found work at Westinghouse engaging in television experiments, filing patents in 1923 and 1925.

Zworykin's initial system was similar to Campbell-Swinton's; it used the cathode-ray tube in both the transmitter and the receiver. Zworykin developed and patented a prototype receiver in 1929 he named the kinescope, and soon after spoke about it at a convention of the Institute of Radio Engineers. This garnered Sarnoff's attention. He hired Zworykin away from Westinghouse in 1930, promising him virtually unlimited funds. Sarnoff didn't care how Zworykin made television work, only that he did – and soon, before a competitor could upset RCA's supremacy over the airwaves. But displaying the image was far less of a problem than capturing it. Zworykin was still using a mechanical device for that half of the television process and it wasn't working out. He had toured Farnsworth's laboratory toward the end of his time at Westinghouse and had been impressed by Farnsworth's all-electronic "image dissector", and believed a much better solution could be found there.

Two years after Philo's impromptu presentation to his science teacher, he and his family had moved back to Utah, where he studied electronics at Brigham Young university. During this time he met his wife Elma Gardner, who went by the name Pem. After a brief foray into a radio repair business with Pem's brother which failed, Farnsworth became acquainted with a pair of San Francisco-based philanthropists who agreed to fund further research into his television ideas, and set up a laboratory for him in Los Angeles. Philo married Pem and they relocated to California, eager to begin their work.

Alan Archibald Campbell-Swinton was a Scottish electrical engineer who in 1908 described a theoretical all-electronic television system in a letter to the British scientific journal *Nature* titled "Telegraphic Photography and Electric Vision". He was the first person to suggest that the cathode-ray tube could be used to both transmit and display television images, an idea that would be later turned into practice.



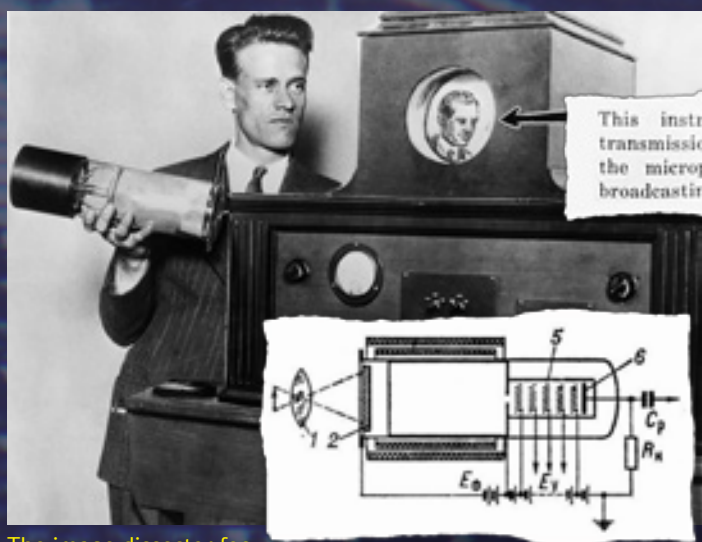
Rigby, Idaho calls itself the "birthplace of television" since it was where a young Philo Farnsworth (inset) first got his ideas.

Television experimentation to that point had employed a spinning mechanical disc to direct a "flying spot" of light systematically over the subject to be transmitted, using an electronic sensor to gauge the intensity of the light reflected back, and sending an electrical signal portraying that varying intensity to the receiver which could then reproduce it either using a variable light bulb and another spinning disc or using a cathode-ray tube (see [Gadget Graveyard](#)). This method was extremely restrictive – flying spot scanners were fixed in place and needed complete darkness. While improvements and variations in the method were developed, Farnsworth felt that capturing a television image should be as easy and straightforward as using a film camera, with all of the functionality they provided. And so, he developed a cathode-ray tube similar to the one Campbell-Swinton proposed.

Farnsworth's image dissector tube contained a photocathode plate (a plate coated with a photosensitive material that emits negatively-charged electrons proportional to the amount of light it is exposed to) on one end. Lenses outside of the tube focussed an image on to the plate, and electrons were then released as a result, attracted to a positively-charged electrode (the anode) at the opposite end of the tube. However, an aperture (or small hole) only allowed a section of the electrons through, which would then hit the anode and create an electrical signal, measuring the light hitting the associated area on the plate. Rather than physically moving the aperture around in order to "scan" the complete image, magnetic fields were used to shift the flow of electrons from the plate, obtaining the same result with no moving parts.



Vladimir Zworykin was born in Russia in 1888, and studied in St. Petersburg, helping his professor with experimental work on "electrical telescoping" – aka television. He graduated in 1912, and went to study X-rays in Paris. He emigrated to the United States during the Russian Civil War (1917-1922).



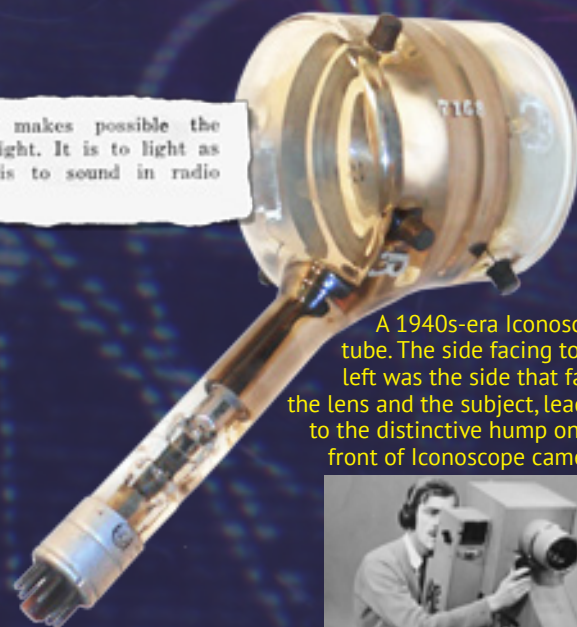
The image dissector focussed the image to be captured on to a large “photocathode” plate that emitted electrons, a tiny portion of which was directed through a small portal to the anode at any one time. It worked, but the output signal was very weak and suffered from contrast problems.

It worked! In 1927 Farnsworth transmitted a simple straight line captured with the dissector, in 1928 he held his first demonstration for the press (where the first image transmitted was a dollar sign, a dig at his investors who “wanted to see money from this thing”), and by 1929 he was able to transmit a live image of Pem. But as most of the electrons released by the photocathode plate were blocked by the aperture the signal from the anode was weak, and it required an extreme amount of light to be cast on its subjects – the associated heat was unbearable, and as a result Pem’s eyes were closed when she became the dissector’s first human subject. Zworykin discounted the image dissector tube as ultimately impractical, and looked for another solution.

Zworykin had previously designed his own camera tube, which he had called the “Iconoscope”, and had filed a patent for it in 1925. It used an “image plate” made of aluminum oxide with an array of photo-sensitive potassium globules on one side and a metal mesh on the other, and a cathode-ray tube to scan it (we will describe this further in a moment.) But, while it worked, the resulting picture had poor resolution. Zworykin would abandon the Iconoscope and move on to other projects.

But now that he was at RCA, work on his camera tube began again in earnest. A breakthrough came in 1931 when one of Zworykin’s underlings, Sanford Essig, left one of the revised plates, made of mica rather than aluminium and coated in silver instead of potassium, baking in an oven too long. Upon examination, he noticed the silver layer had shattered into a large number of tiny silver globules, far more than they had been able to produce by manually placing each one. This would improve the resolution of the captured image substantially, creating the first practical picture.

The revised design worked by using a mica plate covered with an array of “cells” made up of photosensitive material, each of which had a grain of silver at its centre. A layer of silver was also applied to the back of the plate, causing each one of the cells to become a capacitor, able to store a charge, but



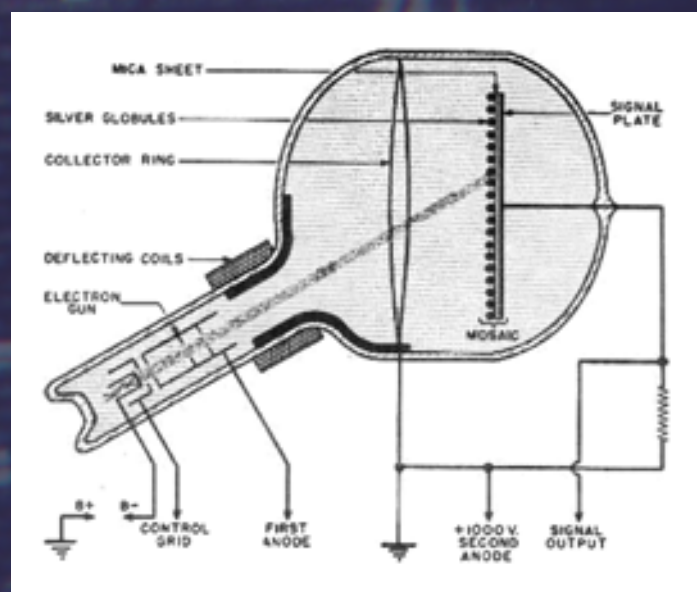
A 1940s-era Iconoscope tube. The side facing to the left was the side that faced the lens and the subject, leading to the distinctive hump on the front of Iconoscope cameras.



never release it. Each one of those cells was like a pixel on a computer screen. A cathode-ray electron gun “charges up” the plate by scanning it. Then, a period of time passes while the photosensitive material coating each cell releases electrons depending on the amount of light hitting them from a lens-focussed image. The more light, the more electrons are released, and the more charge is dissipated.

The cathode-ray gun scans the plate again, and any electrons the cells cannot absorb are reflected back to a ring of metal around the sides of the tube. These collected electrons create an electronic representation of the image, a signal that can then be amplified and inverted, and then used to reconstruct the image using a cathode-ray “picture” tube. Zworykin rushed to patent the new design, late in 1931.

However, Farnsworth had patented many elements of his “camera tube” and that was going to eventually prove problematic for Sarnoff. In 1931 he offered to buy Farnsworth’s patents for US\$100,000 but only if he went to work for RCA.



The Iconoscope converted an image into electrical signals by scanning a mica sheet covered with silver globules coated with a photosensitive material upon which the image to be captured was focussed. The residual (unabsorbed) charge was collected and indicated the varying brightness of each line of the image.

Despite investment having dried up in the wake of the 1929 stock market crash, Philo refused, and instead joined the Philco company in Philadelphia, Pennsylvania, moving there with Pem and their two children. Sarnoff retaliated by filing a patent-interference lawsuit against Farnsworth, claiming that Zworykin's 1925 patent took precedence. To make matters worse, Sarnoff threatened to stop licensing RCA's radio patents to Philco, and in 1933 it severed its relationship with Farnsworth. Things looked bleak for Philo, but his old high-school teacher had kept copies of some of his early diagrams, and he won the patent case. But Sarnoff threw his army of lawyers at Farnsworth, filing a number of appeals and injunctions.

By 1935 Philo had formed a new company, and he demonstrates a fully-functional television system in the summer of that year, but because of his patent fight with RCA nobody invests. At the invitation of John Logie Baird, Philo travels to Europe, not just to demonstrate his working system, but also in a quest to find funding for it, and he finds some success, licensing his image dissector tube to a German company, which used it to broadcast the 1936 Olympic Games in Berlin.

After Farnsworth returned to the US, he began experimental broadcasts, and invented a process for sterilising milk using radio waves, and a fog-penetrating beam for ships and airplanes. RCA, meanwhile, was perfecting its technology, including the invention of a "photomultiplier" tube that enhanced the Iconoscope's signal, with an aim to launch electronic television at the 1939 World's Fair in New York. Farnsworth had managed to outlast Sarnoff, and RCA was forced to pay US\$1 million in royalties to settle the patent dispute in order to move ahead with their launch, where Sarnoff would effectively declare himself the father of television. When Farnsworth heard Sarnoff had taken the credit, he remarked to a reporter, "The baby has been born with a beard." Sarnoff would ignore Farnsworth's contribution, but at least Philo was set to reap the profits of his invention – or so he thought.

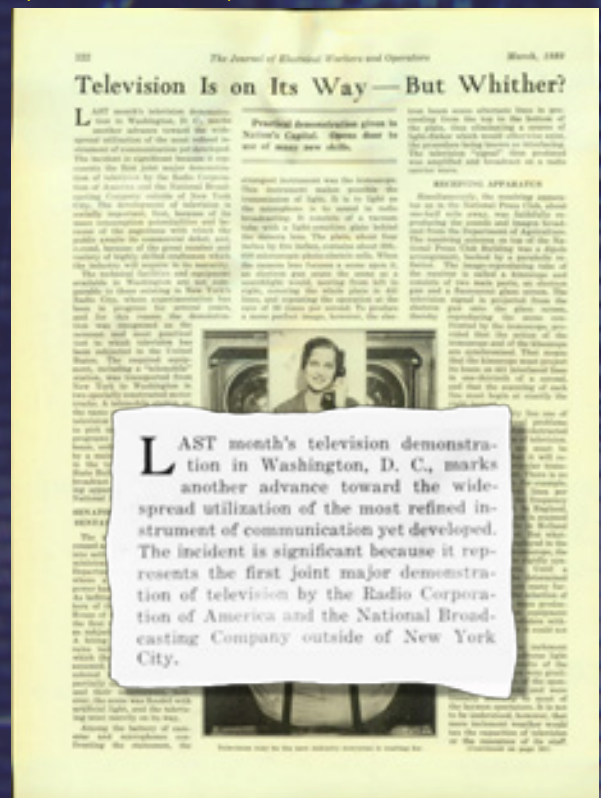
Unfortunately, World War II broke out soon after, and manufacturing facilities in the US were appropriated for the war effort. Television was put on hold, and Farnsworth's patents would expire in the meantime. By the time post-war television started to gear up, Farnsworth was broke, and in 1951 he sold his company to International Telephone and Telegraph, where he worked on a number of inventions, including the forerunner to modern air-traffic control systems. Philo had done much for the invention of television, but saw little reward for it. RCA, on the other hand, moved its National Broadcasting Company into television with gusto, establishing a country-wide network of stations and a slate of television programming that would make it the number one broadcaster for decades.

Sarnoff had won.

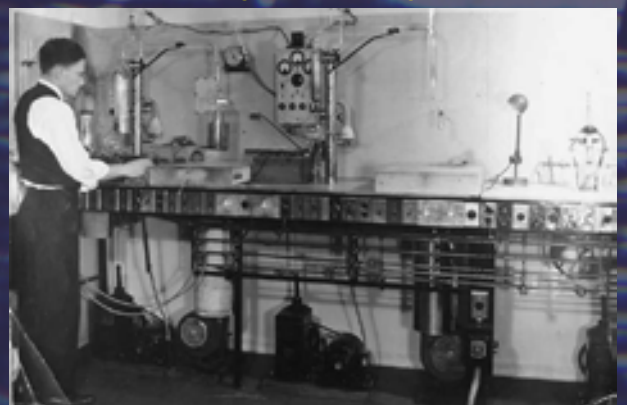
1939: Dawn of present era of big-time tv came when Brig. Gen. David Sarnoff, now RCA chairman, officiated at ceremonies at N.Y. World's Fair to mark start of all-electronic, regular tv programming



The 1939 World's Fair was the second largest such event held on US soil, and featured David Sarnoff's launch of regular all-electronic television programming on behalf of RCA (Radio Corporation of America) and NBC.



Sarnoff's announcement capped off a frenzy of speculation by US media of the day, eagerly anticipating television's launch.



Farnsworth would continue on, developing inventions related to radar and astronomy, as well as research nuclear fusion.

A black and white portrait of a young man with light-colored hair, looking directly at the camera. He is wearing a light-colored shirt. The background is dark and out of focus.

The First Television Stars!



Philo Farnsworth was arguably the first American television personality! The print and radio media of his time fawned over the inventor, who if you took their word for it was single-handedly responsible for the invention and development of television as a whole, having invented it when he was eight. Of course, the UK media did the same for John Logie Baird (coming up next...) although with more typical British reserve.

Radio Guide, July 1936

[illegible]

by WILLIAM FRENCH

Their sales figures will probably lag all the big producers, and Microsoft shows no intention to "dominate" and "obliterate" smaller software developers in the PC market, as they do in Chicago or New York. So you have little to fear the software giant will grab the right-side market by being another "dominant" force and not just a new force.

Other new entrants will not share a share of the software market, but they will share the market for hardware. "We're going to be a hardware company," says Bill Gates.

"Microsoft" is not going to be a hardware company, and neither is Apple, and neither is IBM.



The fact that within three generations the American population will be 200 million is a sobering thought. It is a sobering thought because it means that the American people will have to produce enough food, clothing, shelter, and other necessities to support 200 million people. It is a sobering thought because it means that the American people will have to produce enough food, clothing, shelter, and other necessities to support 200 million people. It is a sobering thought because it means that the American people will have to produce enough food, clothing, shelter, and other necessities to support 200 million people.



One tantalizing difficulty is the problem of perfecting a suitable coloring of the fluorescence in the miracle tubes. It's green now, and Germany's is yellow, but to get a perfect high definition image, you really ought to have black and white, which in television circles is not a drink, but a hangover.

Grayscale television screens didn't start out black-and-white – the colour depended on the material used to coat the phosphors, which as this 1935 article attests came in green and yellow (amber). Thankfully a coating would be developed that glowed white, but green and amber would live on in 1970s and 80s computer monitors.

GADGET GRAVEYARD

Going a different way: long before Philo T. Farnsworth and David Sarnoff duked it out in the United States, a Scotsman had already been driving his idea of the future of television far away in another direction – a mechanical one.

John stood there, on the cliffs above the shoreline near Hastings, on the south coast of England, gazing out at the ocean, and sighed. He was cold, tired and generally miserable. He was always cold, tired and generally miserable.

Why on Earth did he come back to this? Trinidad was warm. He should have taken his doctor's advice and stayed there. But, always the entrepreneur, he had become bored – as he always did – and decided he could sell tropical marmalade made out of Caribbean fruits back in Britain for a packet. Which he would have – if the marmalade hadn't become infested by maggots on the sea voyage back. Worthless! Just like his glass razor blade. All it took was a microscopic little chip out of it and the only guarantee would be that you'd cut yourself every time. His only success had been Borax-infused under-socks sold to World War I soldiers to prevent trench foot – they did and John had made a bit of money, but the marmalade fiasco had burnt through most of his savings, and after a brief, failed venture opening a soap shop in London ("Baird's Speedy Cleaner"... what had he been thinking?), he was near the last of it. He couldn't go back to Trinidad if he wanted to. He shouted silently at the sea, "Why? Why me? Why John Logie Baird? Why?"

He didn't expect an answer. After all, he had always pulled himself up by his own under-socks (ha ha) – born in Scotland in 1888, John had grown up in the small fishing village of Helensburgh, the son of a church minister. He had three older siblings so he was far from doted upon, despite being sickly and frail. He hated the emphasis society placed on physical activities like sport and fighting and war, and looked up to technologies that enhanced the human experience, like motorcars, telephones and cameras – one of the latter he bought with pocket money careful-

ly squirrelled away. When he was twelve he strung telephone wires between his house and the homes of four of his friends, but was forced to take them down after a horse-bus driver had his hat knocked off. But he wasn't discouraged, and in his thirteenth year he built a generator – his house was the only one in the village to have electric lighting! He was constantly dreaming about how not just to improve his own frustrating life, but the lives of people in general.

When he was eighteen, John Logie Baird – or JLB as he was known to his friends – went to Glasgow to study engineering. It took him eight years to finish, because he was often too unwell to attend classes. When World War I started, he tried to join the army, but was declared unfit, and was forced to work in a factory instead, where he found the work tiresome and he swore he would invent something – something that would provide him with a happy life. Then there was the socks, which did well, and then the other things, which did not. And there JLB was, standing on the Hastings shore in early 1923 at the age of thirty-five, desperate for an idea – any idea! Manual labour was not for him, he only had his mind, with which he pleaded to provide an answer to his query: what do I do now?

Perhaps by revisiting some of his failed inventions he could divine how to improve them, or maybe they would provide an inspiration for something new. He flipped through his mental scrapbook – we won't embarrass JLB by recounting the details of his more



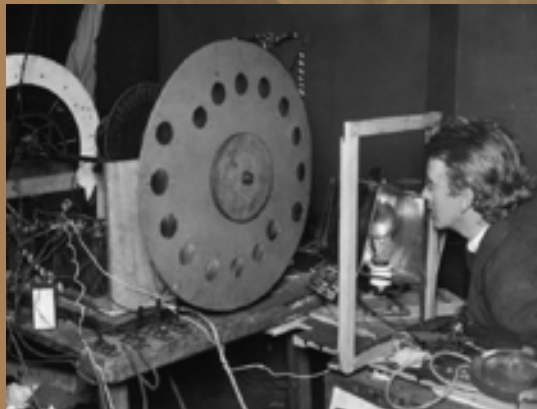
outlandish exploits (although there was that attempt at making a flying machine that crashed into his mother's garden – with him in it, and who could forget his homemade haemorrhoid cream? He sure couldn't!), but instead we'll just skip right to the end of his internal parade of personal disasters. When John was a teenager, one of the things he dreamt of was the ability to “see” radio – that is, a radio that received and displayed a moving picture, as well as sound. But at the time it was pure science fiction – there wasn't even a place to start. Maybe that had changed? If he could make it work, there would certainly be money in it – he was sure of it.

JLB walked back into Hastings and went to the library, where he did a little research. He learned of two important inventions of which his teenage self had been unaware. The first was the Nipkow disk. Invented by a German, Paul Gottlieb Nipkow in 1884, his disk was perforated by a series of offset holes. As the disk spun, an image displayed through it was visibly broken up into a series of lines. In theory you could read the image with an “electric eye” and reconstruct it with a light bulb and another disk. If you had an “electric eye”, of course. Which leads us to the second invention.

Previous “electric eyes” – or photocells, which can electrically measure light – were too weak to have any usefulness, as they required extreme amplification. But between 1902 and 1907 German scientist Arthur Korn invented signal-conditioning circuits that improved the output from photocells, removing the necessity for high voltages and enabling him to send still images over the radio and telephone. JLB was easily able to put the two together, and excitedly rushed off to acquire the needed parts for a prototype – but on a budget.



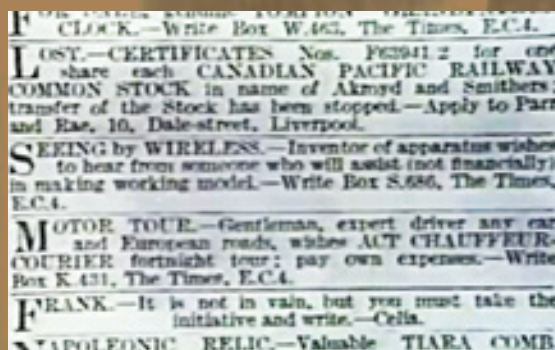
Baird in 1917 at the age of 29. The youngest of four children, Baird suffered throughout his life from a number of conditions related to hypothyroidism, which made him chronically cold and fatigued. In spite of this adversity he pursued a number of varied ventures, before settling on television as his calling, which he significantly aided with his efforts at invention, promotion and advancement.



Baird in 1925. By this point he was well on his way in his research. This version of his image scanning device appears to use lenses in the disc to focus light from in front on to two (suggested by the two series of eight lenses) sensors, likely in an effort to amplify the weak signal the sensors provided. This would have provided an eight-line output – not exactly high definition!

From various Hastings shops he scrounged an old tea chest, a bicycle lamp and a few lenses, a cookie tin, a hat box, glue, string, darning needles, scissors and sealing wax. With these items, and the aid of an old school friend and current house-mate Guy Robertson (known as “Mephy”), he built a rudimentary Nipkow scanner, with lenses in the holes of the disc which focussed the light from a subject in front of it on to a point behind it. John used the motor from an old electric fan to spin it. Confident he could make it work with a bit of additional assistance, he posted an advertisement in The Times of London seeking help developing his invention. The Chief Engineer of the British Broadcasting Corporation (BBC) saw Baird's posting and went down to Hastings to visit him, subsequently sending some much-needed equipment.

After that, JLB acquired the remaining electronic components needed for his apparatus, including a photocell, and began to work out the finer details. His father read of his experiments and sent him fifty pounds, which he used to rent a workshop. He was also contacted by Will Day, a London cinema owner, and together they formed a partnership and applied for a preliminary patent on Baird's invention in mid-1923. Excited, JLB wrote to a friend that he had “invented a means of seeing by wireless” to which his friend responded that he should've stuck to soap. JLB was undeterred. With the assistance of local radio shop owner Victor Mills, he developed a prototype that transmitted (by wire, which required electronic motor synchronisation of the scanning and the display disks – no small feat) and reproduced a silhouette of a cardboard-cutout Maltese cross. Despite the contraption being somewhat dangerous as the lenses were prone to break free from the scanning disk at high speed, JLB demonstrated it for British publication the Radio Times in early 1924 – luckily it all held together.



Baird's help wanted advertisement.

However, JLB's luck must have run out because in July of that year he burnt his hand in an electrical accident and his landlord threw him out. But JLB wasn't going to give up that easy. In the spring of 1925 he returned to London and gave a series of public demonstrations at Selfridge's department store – while they were met with a generally positive reception, the enthusiasm for silhouettes was limited. People wanted to see detail, and in his subsequent quest to achieve that, his scanning disk grew to over eight feet in diameter, with lenses 8 inches wide. Using an intense amount of light he successfully transmitted a 30-line grey-scale image of the head of a ventriloquist's dummy he nicknamed "Stooky Bill". He then ran downstairs and fetched an office assistant, William Taynton, who had shown a keen interest in Baird's experiments. JLB paid Taynton two shillings and sixpence a week to sit in front of the hot lights while he calibrated his equipment. Eventually, one day JLB was able to see Taynton's face – which he confirmed by asking Taynton to stick his tongue out. He did, and the first human image was confirmed to have been broadcast.



Baird publicly demonstrating his invention. The "danger" sign visible in the bottom-right corner of this photograph is there with good reason! The disks in Baird's invention spun at quite high rates, and early versions of the image scanner had glass lenses bolted to the disk that had the potential to come free and cause serious injury. No inventor would dare take this kind of risk these days, lest they face a disastrous lawsuit.



Stooky Bill was a ventriloquist's dummy Baird used as a test subject for his experiments.

Looking to spread the news of his achievement, JLB went to the Daily Express newspaper office, but the editor thought he was a lunatic. And perhaps in some ways he was – spinning at 750 RPM, during one fateful experiment the eight foot tall disk broke free, sending lenses flying everywhere and bouncing around the laboratory before destroying itself. Luckily nobody was hurt, but if JLB wasn't careful his invention could lead him (or others) to a literal "dead end".

Meanwhile, an American, Charles Francis Jenkins, was also demonstrating a silhouette scanning device, in the United States. An accomplished inventor himself with many patents relating to motion pictures, Jenkins had the potential to soon innovate his way past Baird. And so JLB went back to the metaphorical drawing board, to see if he could improve his invention, and hopefully get ahead of the competition. He went so far as to get a friend to steal a human eyeball for him to dissect, but Baird was no surgeon and the only



The first person ever televised, Baird assistant William Taynton.

result was a ghastly mess. He revisited his existing contraption and after some deliberation realised that he may have had it backwards the whole time – rather than using lenses in the disk to focus the light reflecting from a subject onto a single photocell, which often limited the details of the subject to shadows, what if he used the disk to throw a "flying spot" of light on to the subject instead, and then capture the light reflected from the subject using an array of photocells placed around it?

Rather than flooding the subject with light, it (or him, or her) would instead need to sit in complete darkness – except for the spot.

Baird built a new prototype, which worked beautifully. In January 1926, he held a private demonstration for members of the Royal Institution and a reporter from The Times in his second-floor walk-up laboratory, but was extremely secretive about how the new version of his invention actually worked, fearing word of his discovery reaching competitors such as Jenkins.



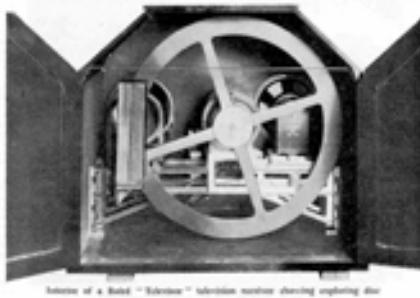
Baird demonstrating his invention with two dummy heads. He found that in early experiments a human face didn't have enough contrast to replicate a recognisable image, but a dummy head did when its features were painted in with dark enough paint. Dummy heads also didn't complain about the hot lights!

Visitors thought his reluctance to disclose details meant his “televisor” was a sham, and apparently crawled underneath the apparatus in an attempt to expose it as a fraud. As a result reports were largely negative. But JLB soldiered on. In 1927 he transmitted a long-distance signal over 438 miles of telephone line between London and Glasgow. In 1928 he developed a colour scanning technique, and made the first transatlantic television transmission from London to New York. He also aired the first television programme for the BBC – and reportedly often did all of this with the aid of only a single laboratory assistant.

During this time JLB began to sell 30-line Baird Televisors, both in an expensive fully-assembled form which cost 26 British Pounds (over US\$2000 in today’s terms), and as a much cheaper kit for hobbyists.



A Baird “televisor”. The image was displayed through the lens on the right-hand side. It was arguably more novelty than practical!



Above: A hobbyist-built mechanical TV receiver. Below: A presenter in a “flying-spot” studio.



It used a neon tube to light the “screen”, which glowed orange. In 1930 the BBC broadcast a half-hour television programme on weekday mornings, produced in Baird’s facilities, and two half-hour midnight broadcasts on Tuesdays and Fridays. Could you image paying US\$2000 for that? But people did. In July of 1930 the first drama program was broadcast, “The Man with a Flower in his Mouth”. This was a static play wherein each actor took turns speaking a monologue to the camera, quickly exchanging places with another after a checkerboard card was slid between them and the camera. The production was simple, but the audience loved it. In 1931 Baird Television made its first outdoor broadcast, a horse race. Instead of the flying spot scanner, they used a rotating cylinder covered with a series of mirrors, each tilted slightly differently, and each providing one scan line. This worked well in sunlight.

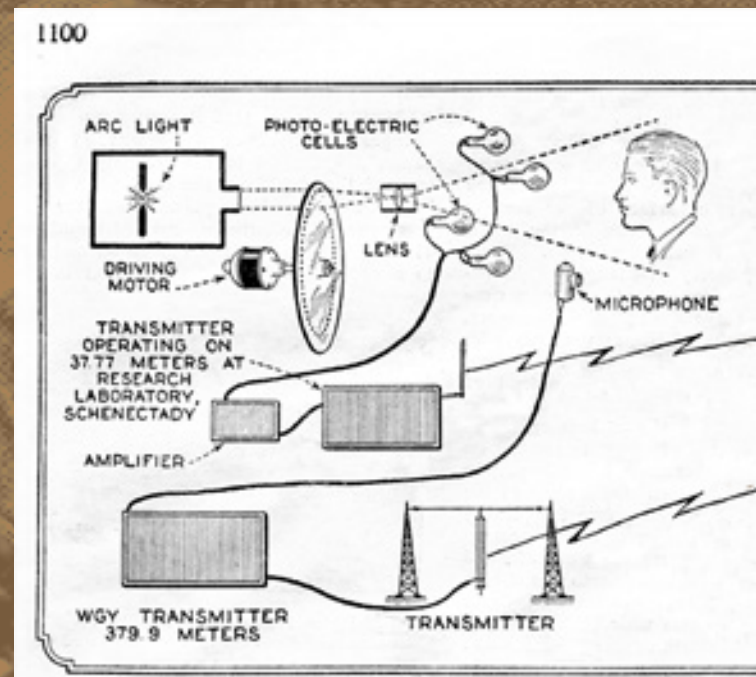
Not everyone was impressed – Alan Campbell-Swinton, the Scotsman who originally proposed all-electronic television, called Baird and other mechanical television promoters “clever rogues” and accused them of “fleecing the public”. He was certain electronic television would arrive soon, and thousands of people would be left with worthless, obsolete equipment. But the public was impatient, and sales of mechanical television receivers (called television “sets” as the radio receiving equipment, audio amplifier and visual display unit were usually separate components) continued to climb.



Baird demonstrates a more modern (and safer) version of his system.

In 1932, the BBC launched its own studio. At its inaugural broadcast, the BBC inexplicably snubbed Baird, forcing him to stand with the press, and giving him no credit for his part in the enterprise. In response, Baird opened an expansive television production facility in 1933, under the 92,000 square metre Crystal Palace, a cast-iron and plate-glass structure originally constructed for the Great Exhibition of 1851, in London. It had smaller studios equipped with flying spot scanners, and three large studios which used film cameras. Film could be developed at leisure and broadcast later, but due to the concerns of cinema owners (who didn't want competition in the "pre-recorded" space) and the novelty of "live" broadcasts, Baird developed a machine that could expose, develop, scan and transmit film in 54 seconds from start to finish.

Film would go straight out of the camera and into a cyanide tank for developing, which would often leak, and actresses were known to drag the hems of their gowns through cyanide puddles on their way into the studio. After the cyanide tank the film would travel through a water tank, where it was also scanned in a fashion similar to Baird's original invention, with the disk allowing light through it to fall on a single photocell. However, air bubbles would often form inside the water tank between the film and the scanner, and someone would need to kick the tank every so often to disperse them. Also, the disk spun at 3,000 RPM (in a vacuum, to avoid air turbulence), creating a noticeable hum, and the telecine booth had to be sound-proofed. It was no where near ideal, but it worked, and at that point it was all there was.



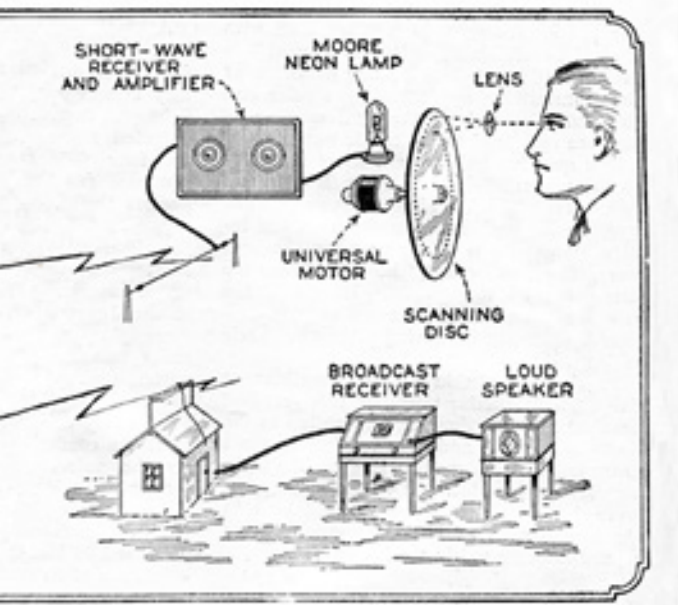
The components of a "flying-spot scanner"-style mechanical television system. A bright light shines a spot through a Nipkow disk (right), which scans a subject. The reflected light is collected by photo-electric cells, which generate a luminance signal. The signal is broadcast to a receiver, which reproduces the image.

However, unfortunately for those who purchased Baird Televisors, Campbell-Swinton would soon be proven right. Philo T. Farnsworth's advances in cathode-ray tube-based "high-definition" television led the BBC to demand a system with more lines – at least 240. To encourage its development, 30-line transmission was terminated in 1935. The public was furious, but the BBC was unmoved. Baird Television developed a 180-line system, and then a 240-line system, which used four rows of holes on a large scanning disc, with a smaller overlaid rotating disc which only let light through one hole at a time. These used cathode-ray tube-based television sets as receivers. Meanwhile, Marconi, the Italian radio manufacturer, and British company EMI teamed up to develop an all-electronic system. Marconi had a research and patent-sharing arrangement with RCA, which they leveraged to create the Emitron 405-line camera tube.


But the Emitron tube was not perfect, and while it technically broadcast more lines, the Baird scanning disk still produced a superior picture, especially the telecine machine, despite its flaws. The BBC was unable to reach a decision on which system to move forward with, and proposed a contest between the two systems. For six months, starting in November 1936, both systems would be used to alternately broadcast programs, and at the end a winner would be chosen. But JLB would play no part in the race, as he was reportedly forced out of the day-to-day operations of Baird Television, continuing with his research out of a small laboratory attached to his home about a mile from the Crystal Palace studios, once again with a single assistant, where he worked on colour television using tinted scanning disks placed in front of a black-and-white cathode-ray tube. His work would serve as inspiration for a colour TV "upgrade" device sold in the 1950s, known as the Col-R-Tel (see page XX).



Advances by Farnsworth and Zworykin in all-electronic television caused Baird's 30-line system to fall out of favour with the BBC, who felt the future was in "high-definition" television. In 1935 they stopped 30-line broadcasts, leaving thousands of Baird Television owners with expensive paperweights. However, the bulbous cathode-ray tubes in the televisions that subsequently replaced them were so large and long they had to be stood on end, and the image they created reflected off of a mirror! "Through the Looking Glass" indeed...



Baird would continue to work, developing a colour television camera (which used a very bright CRT as the light source, and a tinted scanning disk) used for early television broadcasts by some American television systems, well into the 1960s. He also developed the first colour cathode-ray display, using two electron guns firing on the opposite sides of a semi-transparent screen suspended in the centre of a bulb, which created a superimposed two-tone colour image. This "bulb"-style picture tube would also be used to create experimental large-screen televisions with a 28-inch display. He also worked on three-dimensional television, "cinema television" projectors, and a system of transmitting documents as still television images reminiscent of later fax machines. There are also rumours he had some involvement in the development of radar (see [Heavy Duty](#).)

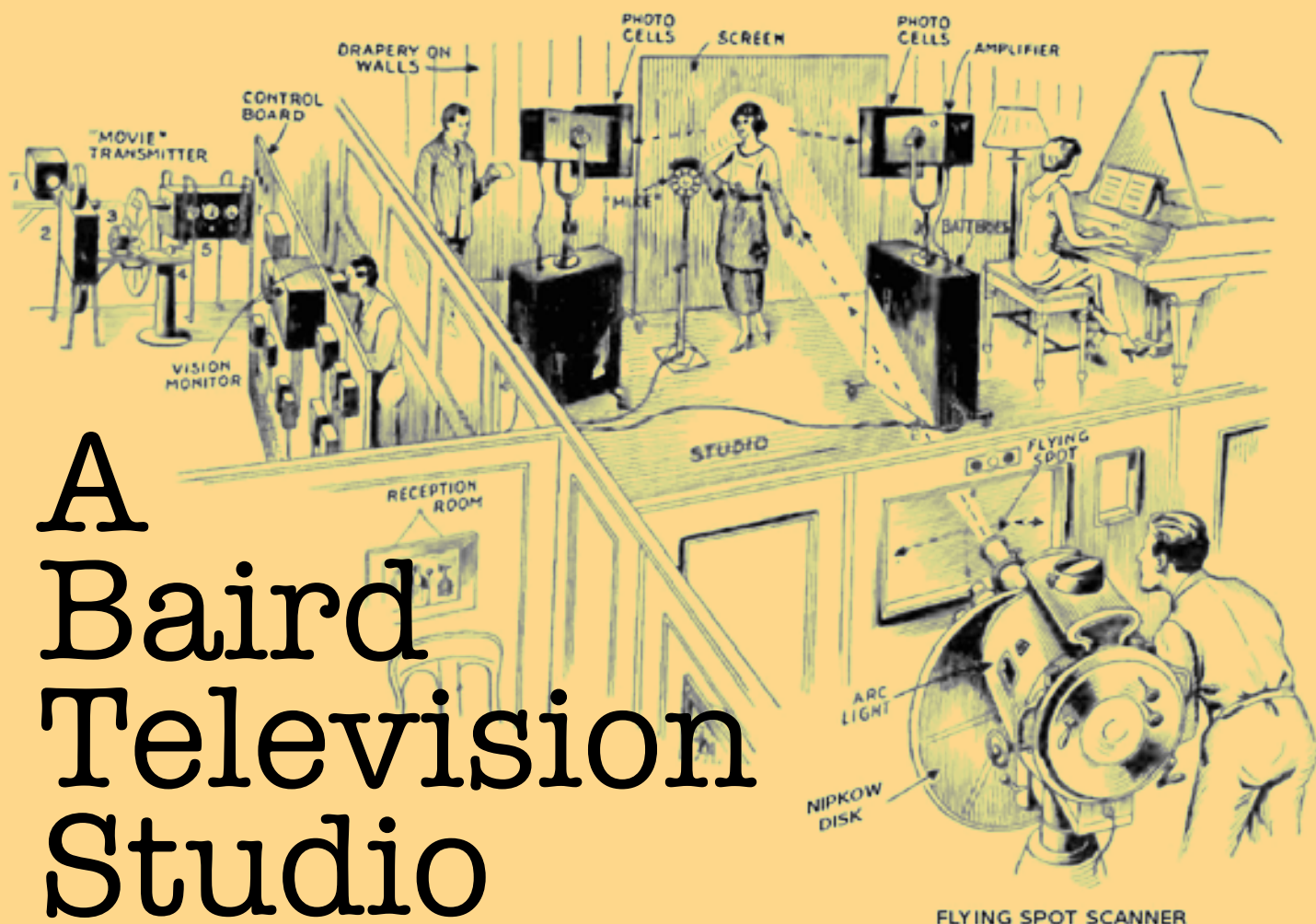
John Logie Baird died in his sleep in 1946, not long after the end of the Second World War, but his legacy would live on in many forms, including the scanning disk-based colour television cameras used to broadcast from the site of the moon landing in 1969. JLB's mechanical system may not have become what we think of today as television, but without his technical inspiration and contributions in developing a market for it (and thereby encouraging others to engage in competition to conquer it), television may have come later, or perhaps never even happened at all. For that, we all owe him a great debt of gratitude. 

To provide neutral ground for the trials, the BBC built new studio facilities inside Alexandra Palace, another exhibition complex originally opened in 1873. There was a Baird studio and a Marconi studio, and it wasn't long before performers made their preference known, begging BBC management to schedule them for the Marconi broadcasts, while failing to turn up for the Baird ones. While the image they provided may have been superior, Baird's telecine-based cameras were fixed in place and could only zoom in on a fixed point, making productions look rather plain. And for close-ups, presenters needed to use darkened flying spot-based booths, which meant they had to memorise all of their lines – they couldn't see cue cards. Later on, Baird employees devised a strobe light that flashed between spots and allowed the talent to see what they were doing – sort of, but it was headache-inducing, and "they didn't need to do that in the Marconi studio". Out of desperation, they tried using Farnsworth's image dissector-based cameras, but the picture they output was actually worse than the existing mechanical methods (and the Emitron), and they quickly returned to them.

Viewers, meanwhile, were developing a taste for the more dynamic content of the Marconi broadcasts, regardless of the picture quality. Happily for consumers, CRT-based televisions of the time supported both systems at the flick of a switch, and owners could watch both transmissions. However, the death blow for the Baird system would ultimately come not from their disapproval, but instead arrive early, in February, 1937, in the form of a fire JLB would later speculate was arson, which destroyed the Crystal Palace facilities, where Baird Television had been developing a new telecine system using the image dissector tube. While insurance eased the financial blow to Baird Television, the BBC used the opportunity to justify the immediate discontinuation of the Baird system trial, declaring Marconi-EMI the victors. The war was over, and the BBC would make regular broadcasts employing the Marconi system until 1939, when another war – the second World War – prompted their discontinuation for security reasons.



A Baird Television Studio



FLYING SPOT SCANNER

This sketch describes the various components of a Baird television studio. A flying-spot scanner (bottom-right) scans the performer (top-centre) and the reflected light is collected by the photocells, which generate a signal verified by a monitor (top-left).

The key to the "rapid" development of the movie-camera film was a leaky vat full of cyanide! Air bubbles collected on the film and had to be knocked off from the outside with a good kick.



The biggest problem faced by performers and crew was the necessity for the studio to be in complete darkness during transmission. The sheet music on the piano seems redundant because the pianist wouldn't have been able to see it! Baird technicians devised a flashing "strobe" light that lit the studio briefly between lines of the scanner, but it wasn't much more hospitable than working in the dark.

Ultimately, a solution was developed (shown left in an image taken from a 1976 BBC documentary) wherein the performances were recorded on film which was then "immediately" (in 54 seconds!) developed and then scanned by a flying-spot scanner. But like the scanner, the film camera couldn't move, and production-wise couldn't compete with the mobile Emitron cameras.

The Logie Awards

Named for John Logie Baird, Australia's TV Week magazine has sponsored and organised the annual Logie Awards since 1959, three years after the introduction of television in Australia. The awards themselves wouldn't be broadcast until 1961.

Honours are currently given in various television-related categories, including ten "most popular" nods whose winners are determined by votes lodged by the general public. Fifteen other awards are decided by a panel of Australian television-industry peers.



Baird technicians achieved 240 lines of resolution using a complicated system of two scanning disks spinning at very high speed.

128 THE MEXICANO MAGAZINE

The London Television Cable

A New Network Fourteen Miles Long

By T. R. Robinson

TELEVISION is rapidly advancing to a position of public importance equal to that of ordinary broadcasting. This has been strikingly shown by the laying down of the London television cable.



TELEVISION is rapidly advancing to a position of public importance equal to that of ordinary broadcasting. This has been strikingly shown by the laying down of the London television cable.

What if you wanted to broadcast an event away from the studio? Well, in the early days of television there were no microwave or satellite transmission trucks, and certainly no Internet, so the only solution was a really, really long cable. In the mid-1930s, the BBC installed a fourteen mile (22.5km)-long network of video cables under London, which they used to broadcast the coronation procession of King George VI, the BBC's first outside broadcast.

However, unless you recorded an event with film simultaneously, these broadcasts were one-and-lost. Baird attempted to resolve this problem with Phonovision, recording the luminance signal to gramophone records.

126 THE MEXICANO MAGAZINE

TELEVISION

HI-NOCTOVISION AND PHONOVISION



By use of a searchlight or beam of infra-red rays it will be possible to make visible a scene that to the eye appears to be shrouded in complete darkness, and this may be done in complete secrecy, for the beams of the searchlight themselves will be invisible.

Another very interesting invention due to Mr. Baird is "phonovision," or the recording of sight by means of sound. Those who have been able to tune in their wireless receivers to the wavelengths on which television broadcasts have been sent out may have heard a peculiar groan, varying in pitch, that is quite distinct from the sounds usually heard. Sounds of this kind are produced in all television broadcasts.



But while the gramophone was up to recording 30-line images (some of which have been recently reconstructed from Phonovision disks) the higher frequencies necessary for "high-definition" broadcasts were unable to be captured by the low-fidelity phonograph records provided, and Phonovision was ultimately declared impractical.



Another invention of Baird's was Noctovision, which captured an image from reflected radio waves, similar to modern night-vision cameras which use infrared frequencies to "light" the scene in front of them.

Col-R-Tel: Mechanical TV Redux



In the 1940s, the Columbia Broadcasting System (CBS) in the United States developed a colour television system. The "field sequential" system used a transparent rotating disk with three tinted segments – red, green and blue – placed in front of a black-and-white

cathode-ray tube. Each image frame displayed by the CRT corresponded to the luminosity of the colour currently in front of it, the signal generated by a camera which sampled each colour (RGB) in turn. Viewer's brains assembled the three images into a single full-colour image.

For \$150 and a bit of work you can have

Color pictures on your present television set

The new standard compatible NTSC system sends a color picture that comes in as a black-and-white one on any non-color set. The matching color receiver has a special picture tube with three electron guns, plus a screen having thousands of phosphor dots of the three primary hues. A shadow mask and appropriate circuitry allow each beam to hit only dots of its corresponding color. The picture thus consists of a mosaic of fine color dots, like some color magazines.

The Col-R-Tel converter uses the image on an ordinary black-and-white tube. Feeding back to the tube video information that the set would otherwise ignore, it keys the single electron beam to the proper illumination for each color at each spot on the screen. Then it locks a three-color filter disk in step with the framing frequency, somewhat like the CBS system, producing a color picture.




However, the signal broadcast by the CBS system was not compatible with televisions not equipped with a colour disk, and large-screen TVs required extremely large disks. While CBS did develop an all-electronic receiver for its colour format, it ultimately lost out to the NTSC standard (described in [Radio Waves](#)) and it was abandoned in the early 1950s.

It didn't take long though before some enterprising individuals realised the color-disc method could be applied to NTSC broadcasts, and so they developed a kit that customers could install that converted the YUV colour scheme used by the NTSC standard to the individual RGB frames needed for the CBS system. They could then use a colour disk overlaid in front of their black-and-white television to see colour broadcasts.



TU may have killed the radio star, but not before radio waves made the TV star

So you've invented a video camera (or a scanner) and you've got something to reproduce the picture on, but how do you get the signal from one to the other?

Well, you could do it over a wire. But neither Baird nor Farnsworth dreamt of "cable" television (although that would eventually become a thing) – they dreamt of wire-less television. It's in the name! They wanted anyone to be able to buy a television, go home (or wherever else they wanted to be), plug it into power and watch. So they had to deliver their video signals wirelessly – over radio waves.

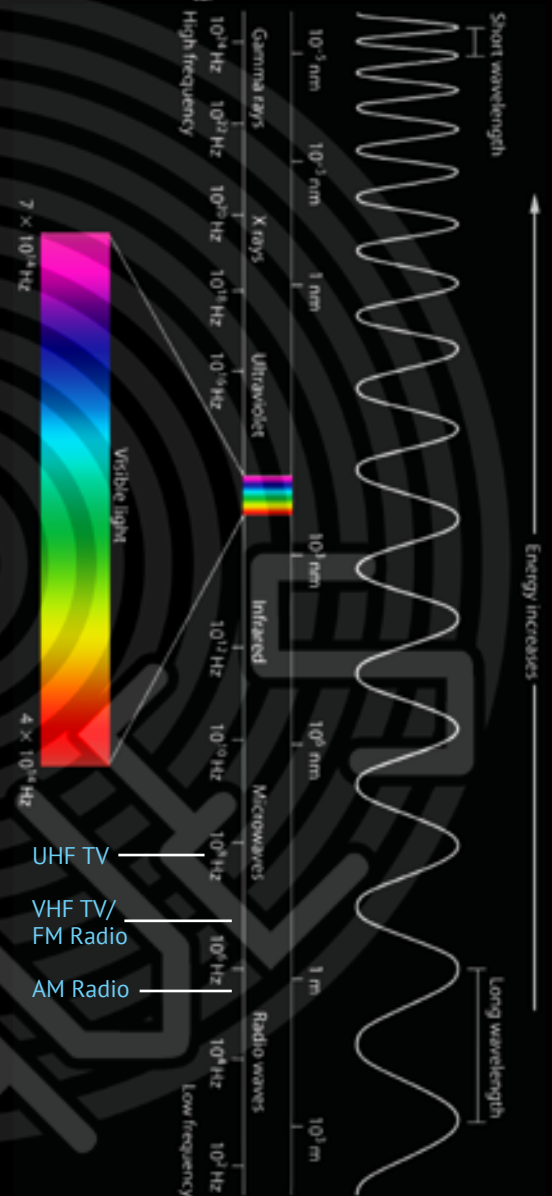
But what are radio waves? Well, in 1867, a Scottish physicist named James Maxwell developed a mathematical theory which proposed that visible light was made up of waves, synchronised oscillations of magnetic and electric fields. The colour of the light an observer saw depended on the "wavelength" (or the distance over which it repeats) of the wave, and Maxwell correctly surmised that a wide range of electromagnetic wavelengths existed outside of the visible light spectrum. In 1887, Heinrich Hertz (for whom the unit of frequency – cycles per second – was named) conclusively proved Maxwell's theory, by generating electromagnetic waves in his laboratory and manipulating them.

In the mid-1890s, Guglielmo Marconi developed the first practical radio transmitters and receivers. By generating an alternating current (an electrical current which rapidly changes direction) oscillating at a particular frequency, amplifying it and then sending it to an antenna, the electrons in the antenna are pushed back and forth, creating a magnetic field which radiates away from the antenna as more current is applied. The electrons in a second antenna connected to a receiver vibrate ever so slightly (more or less, depending on the distance away) due to the electromagnetic waves washing over it, and those vibrations can then be amplified back into the original signal transmitted – great in theory, but in practice there was a fundamental problem.

Early transmitters were designed for wireless telegraphy. In early radiotelegraph systems, an operator used a key to generate pulses of radio waves. A "spark-gap" transmitter consists of two circuits separated by a spark gap – on the generating side, a capacitor is charged until there is enough energy to "spark" across the gap to the other side. Once there, the energy oscillates between a second capacitor and an inductor (a component that stores energy in an electromagnetic field) creating a "pulse" – a diminishing wave in the radio frequency spectrum, which is then broadcast by an antenna. The receiver picks up the wave and sends it to a speaker, where it is reproduced as an audible sound, and a series of waves generated a tone, the qualities of which tended to vary based on the idiosyncrasies of the transmitter, allowing radiotelegraph operators to identify stations by how they sounded. The longer the key was held, the longer length of time the current jumped across the gap, and the longer the series of waves (and resulting tone) lasted for – by holding and then releasing the key for two different lengths of time,

During this period there was a more or less sudden shift from mechanical methods to cathode ray methods. The cathode ray tube was developed to a point where it could respond to pictures of more than 300 lines. Cathode ray transmitting tubes were developed by Zvervkin and Farnsworth which were capable of developing picture signals for these receiving tubes. The important problem now arose—how to link the transmitting tubes with the receiving tubes and complete a television service. From an electronic standpoint (cathode ray) that is still the problem today.

The Journal of Electrical Workers August 1938



The electromagnetic spectrum. Notice that radio waves occupy the low-end of the spectrum, starting with AM at the right (this end) of the chart, then FM and VHF (very high frequency) television (inter-mixed) and then UHF (ultra-high frequency) TV.

RADIO WAVES



Guglielmo Marconi was born in Bologna, Italy in 1874, the second son of an aristocratic Italian landowner father and Scot-Irish mother. Raised in England as a child, he returned to Italy as a teenager and received an impromptu education from his neighbour, Augusto Righi, a physicist from the University of Bologna who let Guglielmo attend lectures and use the university's laboratories, since he did not do well at formal schooling. Marconi pursued the idea of using radio waves for communication at a time when they were viewed only as a scientific curiosity, with no practical purpose.

an operator could transmit the dots and dashes used in Morse code-based communications.

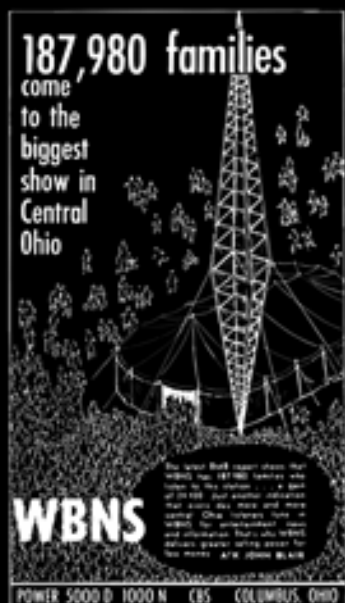
However, the diminishing wave created by the spark-gap transmitter contained a wide range of frequencies, which could drown out other broadcasts. Think about a crowded room, with lots of people talking. You can perhaps pick out a voice here and there, but mostly the noise becomes an undecipherable mess of sound. The only way everyone can hear a single individual is if they all shut up. Now, you could have a deep-voiced man and a higher-pitched woman talk at the same time – people could focus on one or the other and if they concentrated they'd

probably be able to hear what their chosen speaker had to say, but if you pushed it beyond a few people talking at the same time, you would risk making them all unintelligible. This was the problem the spark-gap transmitter caused: it used up far too much of the radio spectrum – too much “bandwidth” – and this meant using a series of smaller-power transmitters which would relay messages over a much wider distance, so as to not risk “walking over” other transmitters.

This was practical for a network of radiotelegraphs, but the RF (radio frequency) spectrum was capable of so much more. So, how to solve the problem? Let's return to our crowded room example. What if, instead of communicating with voices, everyone in the room instead spoke using sign language? Then, when you wanted to “hear” from a certain person, all you would need to do is look at them. Since you aren't looking at anyone else, they will have your undivided attention. The question was, how do we do the same thing with radio stations? Well, let's say the room was dark – sign language wouldn't help us then. What if we gave each person a different coloured light? Then they could flash them in sequences of Morse code, and we would be able to identify who was “speaking” by their colour. So, if radiotelegraph stations only broadcast a wave that oscillated at a single frequency, we could “tune in” to it, and ignore other stations broadcasting using other wavelengths.

This provided a solution to the problem of multiple radiotelegraph stations transmitting at the same time – now you could have two operators in Sydney, one dispatching messages toward Melbourne and the other dispatching messages towards Brisbane, without issue. But what about sending something other than simple tones? Well, in the early 20th century a number of inventors worked on radiotelephony, or sending the human voice over radio waves. However, they soon encountered the same problem – they could broadcast a human voice, but to the exclusion of anything else in a very wide bandwidth. Such broadcasts also used a huge amount of electricity, and didn't reach far. They needed to be able to send the voice in a much narrower bandwidth, reducing the required power. But how? They could truncate the upper and lower frequencies in the voice, reducing its bandwidth, but that created a muddled mess that was hard to decipher. They could shift the frequencies up or down the spectrum, but this strategy still only allowed a few to speak at one time – no good if you envisioned the potential of radio for the simultaneous communication of hundreds or thousands of stations in a given area.

Ultimately, the solution was a concept called amplitude modulation. The principle is actually quite simple: what you do is you generate a repeating electromagnetic wave of a single frequency (say 800,000 hertz, or cycles per second). This is known as a carrier. This frequency doesn't deviate, so it remains in its tidy little corner of the RF spectrum, not interfering with any other frequencies (mostly, but we'll get to that later), and allowing for many, many others to also broadcast. A receiver simply focusses in on the frequency of its desired station (by

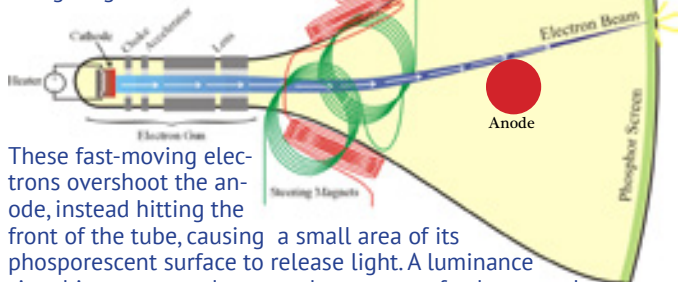


However, after two world wars and fifty years later, radio would've taken the Western world by a storm, becoming the undisputed king of media, with a listener-base even newspapers couldn't rival, as this 1951 advertisement for an American radio station boastfully points out. Things would remain this way until television took radio's crown away in the late 1950s.

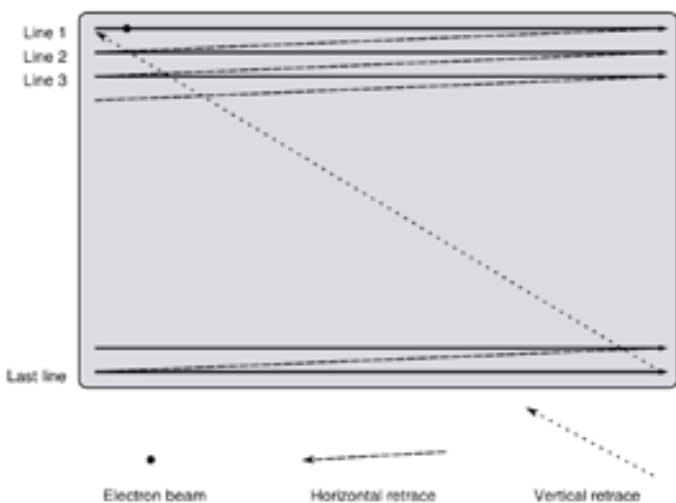
using a bandpass filter to remove other frequencies), like staring at a single person speaking with sign language in a crowded room. But at this point they're just signing the same one thing over and over again, "bird". How can they communicate with us if they can only sign "bird" (beyond informing us that they have a thing for birds?) Well, that's where modulation comes in.

What if the person signing "bird" did so in time consistent with Morse code sequences? Then we could understand them again! This is known as time modulation. But the human voice needs to be transmitted and received in real-time, so time modulation doesn't help us. So what else can we do? Well, what if we varied the intensity (amplitude) of the carrier wave in a direct proportion to the shape of the sound wave created by our voice? Then a receiver could reconstruct this amplitude modulated (AM) signal back into the original sound wave and reproduce it using a speaker. Huzzah! This worked and the age of voice transmission was born. Radio stations sprung up all over the place! But, we're here to talk about television, so let's get back to that – we'll talk plenty more about radio in another issue.

The cathode-ray tube used in a 20th-century television set. High-voltage is applied to a heated cathode, which releases electrons that are attracted to the anode. These are accelerated and then directed using magnetic coils.



These fast-moving electrons overshoot the anode, instead hitting the front of the tube, causing a small area of its phosphorescent surface to release light. A luminance signal increases or decreases the amount of voltage applied to the cathode, varying the number of electrons released and the brightness of the target spot on the screen.



The pattern of movement that the magnetic coils cause the stream of electrons (electron beam) to follow is known as a raster. The common raster starts in the top-left corner of the screen, then moves to the right-hand side, creating a row of light of varying intensity based on the luminance signal. The electron gun then stops firing (at a high level) and the magnets move the beam back to the left (horizontal retrace). This continues to the bottom of the screen, where the beam returns to the top again (vertical retrace) and the process repeats.

International Morse Code

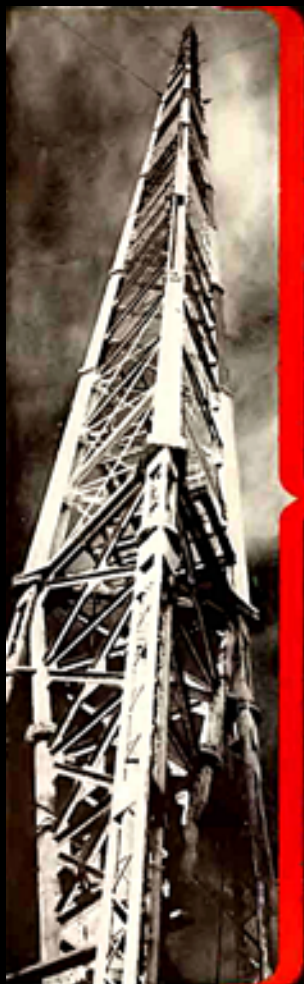
1. The length of a dot is one unit.
2. A dash is three units.
3. The space between parts of the same letter is one unit.
4. The space between letters is three units.
5. The space between words is seven units.

A	• —	U	• • —
B	• • • —	V	• • — —
C	— • — •	W	• — — —
D	— • •	X	— • — —
E	•	Y	— • — • —
F	• • — •	Z	— — • •
G	— • — •		
H	• • • •		
I	• •		
J	• — — —		
K	— • — •		
L	• — • •		
M	— —		
N	— •		
O	— — —		
P	• — — •		
Q	— • — •		
R	• — •		
S	• • •		
T	—		
		1	• — — — —
		2	• • — — —
		3	• • • — —
		4	• • • • —
		5	• • • • •
		6	• — • • •
		7	— • • • •
		8	— — • • •
		9	— — — • •
		0	— — — — •

Named for Samuel Morse, one of the inventors of the wired telegraph system, who developed an early forerunner of Morse code.

Baird's televisior originally required three signals to be broadcast for a complete television "program" – the luminance signal, that is the varying amplitude generated by the light-sensitive photocells in his flying spot scanner; a synchronisation pulse to ensure the rotating disk in the receiver kept time with the transmitter; and an audio signal (although not at first – original test broadcasts were silent. How boring!) A viewer would need to tune various components of their television "set" to each of these frequencies in order to receive the broadcast properly. Baird would later incorporate the synchronisation pulse into the luminance signal, and this would be, quite frankly, as simple as it got. You tuned in an audio station and a luminance station and off you went. Baird's 30-line, 16 images-per-second mechanical television operated at such low frequencies (relatively speaking) that you could tune in the luminance signal on your radio and "listen" to it if you wanted (it apparently sounded like a high-pitched squeal, and those who accidentally tuned into it didn't linger there long). But it didn't require any fancy tricks to broadcast or receive it and just used what was there, no fuss and little bother. Simple.

But electronic television would go and make things much more complicated. Not only did it have many, many more lines, but it also scanned them all much more frequently. Cathode-ray tube displays also required a number of timing pulses that added overhead to the signal. Obviously you weren't going to be able to broadcast up to 525 lines of video information at 25 or 30 frames per second on an AM radio band – the carrier waves at those frequencies didn't provide enough internal "bandwidth" to transmit all of that information (you can't modulate a signal on to a carrier wave that has a higher frequency than the carrier wave itself). Also, tuning in a separate station was a pain, and the radio stations didn't want



ZOOMING UP ... MORE THAN 125 STORIES HIGH!

KWTU's new tower—soon to be the world's tallest man-made structure—is rushing skyward toward its 1572-foot destination.

And KWTU's new studios—soon to be among the largest and best equipped in the Southwest—are also near completion.

Here's a glimpse at the KWTU picture you'll have by October 1:

1572-foot antenna
316,000 watts—video
138,000 watts—audio
Oklahoma's largest coverage area*—
1,401,400 population
\$1,326,048,000 retail sales

More people, more money, more
TV homes than any other
Oklahoma station!

*100 strongest over our neighboring competitors. Population and sales figures from the Bureau of Economic Analysis.

Oklahoma's Number 1 television station is heading fast toward new heights of sales effectiveness. You can buy this coverage now for your fall campaign. Ask us for the complete story!

FRED L. VANCE
Sales Manager

EDGAR E. BELL
Executive Vice-President



KWTU - CHANNEL 9
OKLAHOMA CITY

REPRESENTED BY AVERY-KNOEL, INC.

Unlike lower-frequency AM-radio waves, which tended to follow the curvature of the Earth, higher-frequency FM-radio and VHF TV waves usually just flew off into space past the horizon, so the first instinct of early television stations was to build taller and taller antennas.

their territory cluttered up by upstart television folks. So television signals needed to find somewhere else to live, higher up the RF spectrum. There also needed to be the facility for several of them to coexist in the same location – at least a dozen (it was thought at the time), possibly more.

A range of frequencies in what would become the VHF (Very High Frequency) band would be set aside for television. In most regions of the world there were thirteen channels, from 1 to 13, although channel 1 was withdrawn in North America in 1948 and used for other things, leaving 2-13 (occupying 48MHz – megahertz or millions of cycles per second – to 216MHz). In Australia, things were a bit strange. Channels 1 to 10 were originally allocated (57.25MHz to 215.75MHz), but 1-3 were actually placed in the same frequency band used overseas for FM radio (frequency modulation varies the frequency of the carrier wave instead of the amplitude in order to transmit the audio signal; it exchanges the use of more bandwidth for better quality broadcasting suitable for music) – the government didn't think FM would ever take hold in Australia. But as governments invariably were they were wrong, and so channels 0, 5A and 11 were added to replace 1 to 3, making for a very strange channel dial indeed!

So what's actually in the 6 MHz or so of bandwidth used by an analog television channel? Well, first there's the luminance signal – similar to the neon lamp in Baird's mechanical television, the electron gun in a cathode-ray tube (CRT)-based television fires at varying power levels to reproduce the luminance, or shades of grey in an image. To recreate a frame of video, it scans across the CRT horizontally, moving slightly downward diagonally from the left side of the screen to the right. Once at the right side, it moves back to the left hand side without firing, skipping a line. Once back at the left hand side, it repeats the sequence, moving toward the bottom of the screen, reproducing all of the odd lines. Once at the bottom (the number of lines scanned varies by region and television standard, for example 625 lines in the UK/Australia), it moves back to the top, and then the even lines are recreated (this is known as interlacing). The whole process is repeated over and over again, 25 or ~30 times per second (originally depending on the frequency of the alternating current used in your country: 25 in countries with 50Hz electricity, e.g. Australia and the UK; 30 in countries with 60Hz power, including the US and Canada).

A combination of persistence by the “phosphors” (phosphor-coated spots arranged on a grid on the inside of the front of a CRT which follow the pattern of the electron gun) and a mental concept known as “persistence of vision” which allows the human mind to see a moving picture instead of a series of still images) makes this whole process relatively transparent to the viewer, although individuals used to 60Hz television often notice(d) obvious “flickering” when encountering 50Hz TV sets, and with the obsolescence of CRTs, the flicker appears to have become obvious to just about everyone no longer regularly exposed to them.



IN THE GREATER SAN FRANCISCO MARKET ...you cover more on CHANNEL 4

KRON-TV COVERS THIS BIG MARKET...

- With a population of 3,600,000
- Spending 4 1/2 billion dollars annually on retail purchases
- The sixth largest in net ownership

...SO COVER MORE ON
CHANNEL 4

FREE & PETERS, INC. - NATIONAL REPRESENTATIVES

BECAUSE CHANNEL 4 PROVIDES...

- Maximum legal power operating at 100,000 watts
- Highest antenna in San Francisco at 1,661 feet above sea level
- Low channel frequency (stronger signal)
- Top-rated NBC and local programs

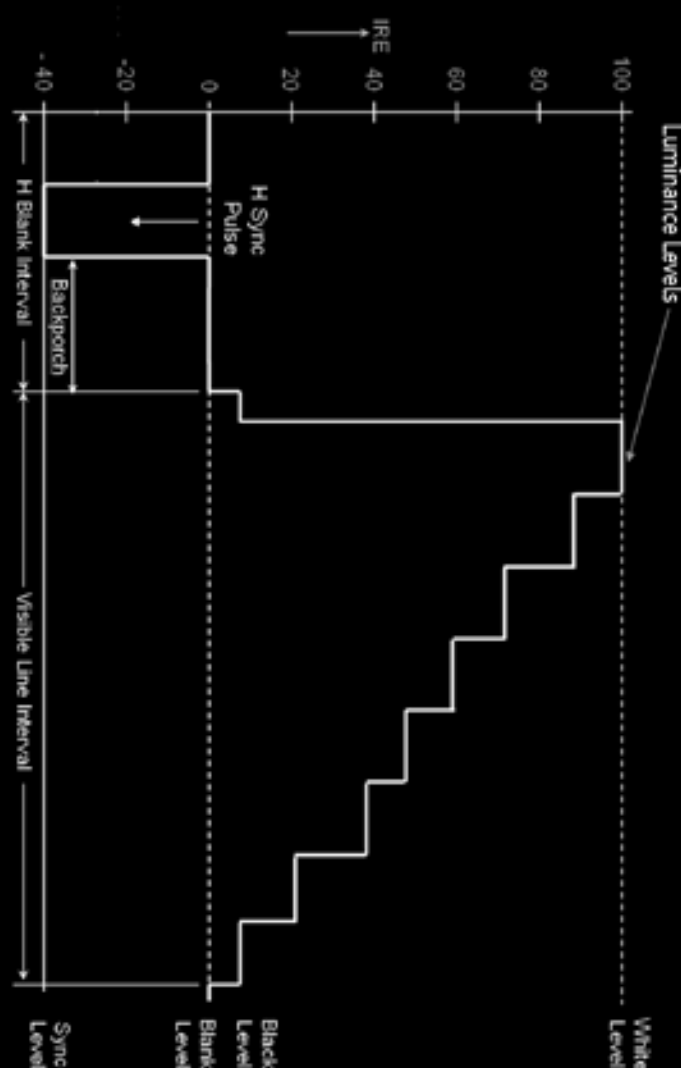
KRON-TV 4
SAN FRANCISCO

In black-and-white (actually grayscale, not monochrome) broadcasts, the luminance signal (which told the CRT's electron gun what to do) was initially made up of a series of horizontal lines comprising the following components: First, the "front porch" is a brief period at 300mV (millivolts) which allows the electron gun to stop firing (to avoid interference during the horizontal "retrace", or return to the left side of the screen). Second, the "sync pulse" (0mV) ensures the electron gun gets into place to start scanning the next line at the right time. Third, the "back porch" warms up the electron gun to get it ready to fire the next line, which it then does (at levels fluctuating from 300 to 1000mV, corresponding to the varying brightness of the line). Once at the bottom of the screen, the vertical blanking interval (VBI) gives time to allow the electron gun to return to the top of the screen. The luminance signal was modulated using amplitude modulation (AM), with audio broadcast as an FM signal alongside it. Together they filled up the bandwidth available in the channel, for the best broadcast quality and range possible.

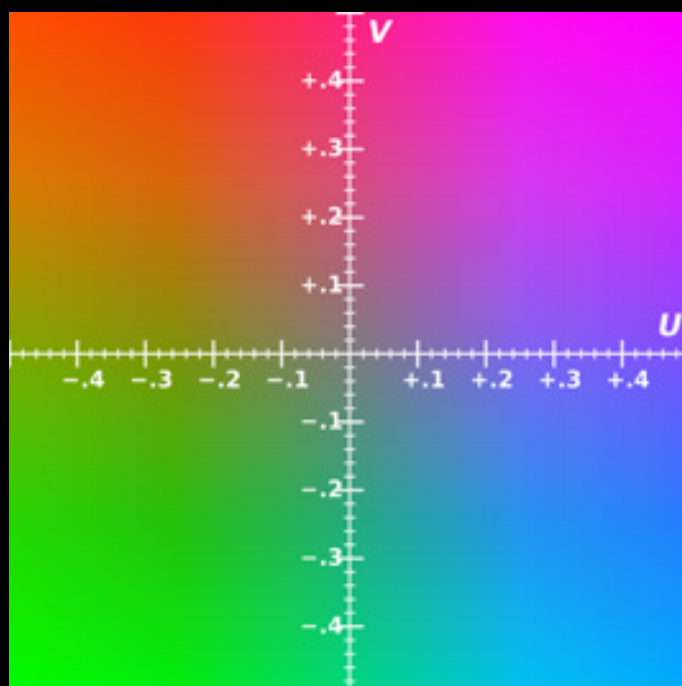
But what of colour TV? Once it became viable, broadcasters were reluctant to broadcast two signals, due to expense and regulations, and so to encourage adoption a method had to be found to allow black-and-white televisions to continue to receive a luminance signal while colour televisions also received the information necessary to reproduce colour – but only using the allocated channel bandwidth. At first, television scientists cursed their decision to fill up the channel bandwidth with the AM luminance signal, but they were stuck with it! However, while researching a solution they discovered that there was a certain amount of (mostly) empty space in the frequencies that made up the luminance signal, in the area that made up the really bright parts of the picture (and where a small amount of interference from a colour signal wouldn't be noticed by black-and-white TVs).

Victory! Well, not just yet. Colour video cameras produced three signals: a red signal, a green signal and a blue signal, the combination of which recreated a "pixel" (or unit of screen area) of the original colour. But there wasn't enough bandwidth available in the channel (even in the discovered "hole") for all those signals. Since black-and-white televisions needed a luminance signal anyway, a method was developed to take the luminance and then re-add the necessary components to colourise it. Together, these components were called YUV: Y being the luminance, U being the difference between B(lue) and Y (signifying how purplish-blue or yellowish-green the colour is), and V being the difference between R(ed) and Y (or how purplish-red or greenish-cyan it is). This scheme had the advantage of allowing colour televisions to reproduce a black-and-white image using the much stronger Y (luminance) signal if the broadcast signal was too weak for the colour signals (U and V) to be (sufficiently) recovered. The combination of U and V was "quadrature" (double) modulated into a signal called chrominance.

This chrominance signal was broadcast in the



A "black-and-white" (grayscale) luminance signal. Each horizontal line contains a sync-pulse for timing, which has a "front porch" and a "back porch" used for the cooling down and warming up again of the electron gun, respectively. Colour TV added a "color-burst" signal in the back porch which told the equipment what sub-carrier frequency the colour information was "hidden" in.



This colour chart shows the gradient created by the U and V values in the YUV television colour scheme. Combined with the luminance signal (Y), this scheme allows for a fairly good colour television image without using a great amount of bandwidth.

available bandwidth hidden in the luminance signal using amplitude modulation (AM) on a “sub-carrier” (a carrier inside another carrier, in this case the luminance carrier) in its “side bands” (it was noticed that due to idiosyncrasies we won’t get into here, when a signal was modulated on to a carrier, complementary signals were generated around the carrier signal. To save on bandwidth, scientists realised that if the receiver of a signal reproduced the carrier wave itself, it was not necessary to broadcast the carrier at all, only the complementary signals, which became known as side bands. We will cover side bands in greater detail at another time.) The combination of chrominance and luminance is known as a composite signal (this signal type is used commonly with video equipment, video-game consoles and 1980s home computers).

A colour television could then extract the chrominance signal, and combined with the luminance signal reproduce a colour image. However, scientists in North America and Europe disagreed about where to put the chrominance signal (and other details), and they developed two different standards, NTSC (named for the National Television System Committee) in the USA, and PAL (Phase Alternating Line) in the UK. This is why older NTSC equipment connected to a PAL television has no colour, and vice-versa.

There was just one more problem to overcome. AM radio stations broadcast below 3MHz, which meant that they can travel as “ground waves”, which due to

their nature follow the contour of the Earth. However, as frequencies get higher, they gradually break free from the contour of the Earth, and once they pass the horizon they simply fly off into space. The VHF spectrum was well past that threshold, and so the broadcast range of a television station with a 100 metre (330 ft) antenna was only 36 kilometres (22 miles). Obviously you could try to increase the height of your antenna, but that had its limits. Advertisers used to the wide coverage of AM radio were reluctant to spend money on advertisements distributed to such a limited area.

The solution was to create broadcast repeaters (also known as translators or rebroadcasters). These transmitters received the signal from the host station (sometimes over-the-air, sometimes by satellite or other method) and then rebroadcast them, sometimes on the same channel, sometimes on another channel. Either way, networks of repeaters would distribute a signal over a broader coverage area, which made advertisers happy, and helped to launch television into the dominant medium.

Well, there you have it. Of course, all of this is obsolete now, with the advent of digital television, and analog television broadcasting has taken its place in the Gadget Graveyard along with CRT-based TVs. But we wouldn’t be here if there hadn’t been a there, first, and there wouldn’t have even been a there without radio waves.

Three cheers for radio! 📻

NATION'S BUSINESS for June, 1936 21

FCC To Talk Bands

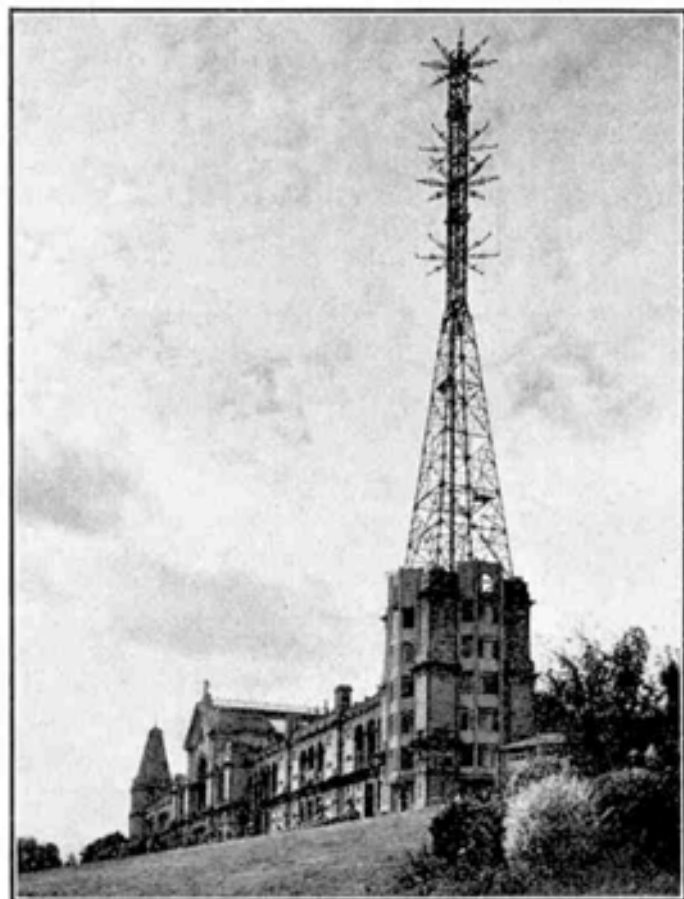
THE Federal Communications Commission has an important hearing beginning June 15. They'll discuss among other things claims for a new large "band of frequencies." A friend who knows tells me:

"There is no room for television in the frequencies below 30,000 kc. and if it is ever to come it must be in the bands of newly developed radio waves. . . . The Army and Navy are obtaining huge appropriations this spring and plan to establish large networks of radio stations using their frequencies. . . . They may block the development of television.

"Underlying are important practical questions, one whether the public will have to scrap its tremendous investment in radio receivers."

There were concerns in the mid-1930s that (at least in the United States) there wouldn't be room for television in the radio spectrum at all, with the American military promoting plans for large networks of civil defence stations – there were even worries public radio could be expropriated for military use.

Marconi made the wireless work, but he did it with the money of men who were willing to take a chance. Government's chief interest in wireless and radios is to find out what people say to 25,000,000 owners, and if possible make 'em stop. Television is in sight now, and government is waiting for a chance to say "you can't do it that way."



The mast and aerials at the B.B.C. television transmitting station, Alexandra Palace. The illustrations to this article are reproduced by courtesy of the B.B.C.



POPPED culture

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Now that the world had a functional all-electronic television system and a way to broadcast a signal to receivers, the question then became: who was going to pay for programming? In the United Kingdom the answer was to have television owners pay for a license fee to operate them, which then funded the BBC, but in capitalist America that wasn't really an option.

American radio had solved their funding problem by first introducing advertising breaks masquerading as station identification, and then eventuating in program sponsorship – by the late 1940s they had monetised every little nook and cranny they could find, even the weather report was brought



The first television sci-fi series, Captain Video and His Video Rangers aired 30 (later 15) minute episodes five nights a week for nearly six years – an estimate 1,537 episodes! However, very few were saved for posterity, the vast majority destroyed. Sponsored by cereal and candy bar manufacturers, Captain Video also sold toys such as a flying saucer ring, a rocket key chain and a ray gun.



to you by someone or another. But one of the things they had found worked the best for making money were radio “serials” – an audio-only version of the popular episodic genre shorts that ran in the movie theatres.

Theatre-goers of the day would see a newsreel, a cartoon, a short (usually a serial) and then a feature all for the price of a ticket. There were crime (Dick Tracy), western (The Lone Ranger), superhero (Superman), science-fiction (Buck Rogers) and even “jungle” serials (me Tarzan, you Jane!)

Early radio programme producers quickly realised serials would be perfect for selling advertising, which was, after all, their product. Serials typically had a hero who battled some sort of evil but ultimately survived to return every week (or weekday afternoon) and do it again, making them easy idols for children to adopt. While these fictional heroes had done well



Inspired by the 1948 Robert A. Heinlein novel Space Cadet, Tom Corbett was originally intended to be a daily newspaper comic strip but ended up being picked up for television, with its first episode airing in late 1950.

Over the following five years it would move between all four major television networks of the time (ABC, NBC, CBS and DuMont), and also become a series of science-fiction novels, comic books, a radio version (including a separate radio version aired in Australia with Australian actors), a musical record and yes, a daily newspaper comic strip.

There were also 3D View-Master reels, colouring books, costumes, lunch boxes, moulds for making your own action figures... you name it, there was probably one with Tom Corbett's name on it somewhere! The show would set a high merchandising bar for those that followed.





returning audiences to movie houses, they also made the perfect spokespeople for selling their young radio audiences toys and cereal.

Hi-ho Silver, away – but not before you eat your Wheaties. And every box now has a sheriff's badge inside, so you can fight the bad guys too! Yee haw!

It was a “golden age” for the townsfolk of Radioville, until one fateful day when Television rode into town on a black horse, wearing a yellow hat and a red bandana... aw shucks, Television doesn't need to describe what it looks like, it can show you! The shootout in the town square between Sheriff Radio and the outlaw Television was short. The sheriff was dead and Television ran off with all the serials. Radioville would never be the same.

After that, the serials were back on the screen, like in the movie houses, but they were selling products not seats, like on the radio. And they did a good job at it. But science-fiction serials benefitted from the move most of all, because while a half-dozen sound effects told you all you needed to know in a radio Western, they didn't help much in describing a futuristic space-age – you really needed pictures for that.

From 1949 to 1955 science-fiction serials were a common fixture on the television airwaves. The first, “Captain Video and His Video Rangers”, ran right through to the end of this period, joined along the way by “Tom Corbett, Space Cadet” and “Space Patrol”. There were brief stints by movie-serial stars “Buck Rogers” and “Flash Gordon”, and later additions “Captain Z-Ro” and “Rocky Jones, Space Ranger”. All of these speculated on what the future was going to be like in the electronic age, seen through an electronic lens, the medium itself inspiring the message, and the minds of millions of young people.

Originally aired locally in San Francisco in 1951, Captain Z-Ro (pronounced Zero) had a time machine and a teenage assistant, who he would regularly send back to correct history which was frequently disrupted by evil forces. (Sound familiar? Now who could that remind you of? Who, exactly?)



Flash Gordon, originally a 1934 comic strip created to compete with Buck Rogers (which would get its own brief stint on TV) became a popular movie serial in the late 1930s, and made its television debut in 1954.

Unlike the original story, where the characters of Flash and Dale are kidnapped by mad scientist Doctor Zarkov in his attempt to save the world from collision with the planet Mongo and are subsequently trapped there, the trio are members of a team working for the Galactic Bureau of Investigation, travelling the galaxy in the year 3203 and battling various villains.

The show only lasted for one season, but is notable for having been filmed in West Berlin, and featuring a strong female protagonist in its interpretation of Flash's love-interest Dale.

“Submitted for your approval...”

Captain Z-Ro would break free of its Californian shackles and get a nationally syndicated run in 1956, airing all of its episodes across the United States over a six-month period.

The Television Zone

ROCKY JONES SPACE RANGER

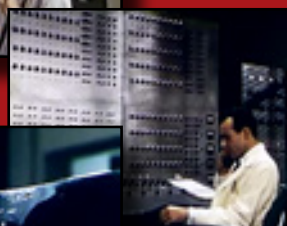


Rocky Jones, Space Ranger was recorded using film instead of television cameras, which allowed for more elaborate sets, outside / off-studio scenes and better special effects. Most episodes have survived and can be watched on YouTube.

Science Fiction Theatre was a sci-fi anthology series broadcast from 1955 to 1957. Each week had a new story and cast. The first season was filmed in colour, which was notable for the time.

But as exciting as that was – at least in the beginning – the budgets for these programmes weren't large and after a few years the stories, sets and costumes became repetitive and boring. By 1955 the public began yearning for the westerns of yesteryear, and the science-fiction serials were shelved. However, science-fiction didn't disappear entirely – it was realised in the early 1950s that space stories could be used to sell cars just as well as cereal, and the first anthology series – where each episode had a self-contained plot with different characters and actors – "Tales of Tomorrow" debuted in 1951, to be followed by "Science Fiction Theatre" and "The Twilight Zone", the last one cementing science-fiction into the mainstream forever.

SCIENCE FICTION THEATRE



The host of Science Fiction Theatre, Truman Bradley, would explain a scientific (or speculative) concept relevant to each episode to the audience.



Head writer Rod Serling also hosted The Twilight Zone, with his trademark cool and dispassionate style often in sharp contrast to the strong moral and emotional messages embedded in his own screenplays. The anthology series launched the careers of a number of actors, including Star Trek's William Shatner.

"The Twilight Zone" would open the door for a new sub-genre of science-fiction television, the space opera, which featured larger casts of characters and more dynamic plots and messaging than the simplistic space serial's heroic battles between good and evil. But that's a region of uncharted space we will boldly go and explore at another time. For now, you can join the Paleotronic Space Rangers club for an entry fee of only \$5, sent along with your name and address care of this station. Stay strong, Space Rangers, and see you next week! 📺



Serling believed science-fiction would allow him to explore more controversial social concepts without interference from the networks. A famous example is the episode "To Serve Man", where an alien attempts to sell humanity on the benefits of "co-operation", when the true intent is much more sinister – a not-so-subtle commentary on imperialism.



From science-fiction **on**
the tube to science-fic-
tion **in** the tube...

CRTs didn't just make good televisions, they also made great windows into the world of computers. Prior to CRT monitors, interfaces with mainframe computers were typically panels of lights or paper printouts. But in the 1960s some mainframes were equipped with oscilloscope CRTs which could do vector graphics, and with reduced memory costs in the early 1970s, monitors capable of displaying text became practical. These were known as terminals since they connected to their mainframe host externally, (usually over a network) and had their own built-in computer for displaying information and managing communications. In the mid-1970s, microcomputers began to connect to monitors directly, enabling the development of better graphical capabilities such as the ability to draw raster-based shapes, later in colour. These improvements led to the rise of video games.

Inspired by Pong, film writer/director Steven Lisberger began development on an animated feature in 1976 he called Tron (short for electronic) set inside a digital world. He wanted to create that world using a combination of back-lit animation (shining light through cut-out mattes) and computer graphics, but the first process was labourious and the second impractical for any fine detail in the late 1970s. It was decided to combine live-action shots with animation instead.



Instead, Disney collaborated with a number of outside computer-graphics companies, designers and traditional animators. But work was slow and expensive, and Tron's budget blew out to US\$17 million. Despite being well-received by critics, it only grossed US\$33 million in North America when released in 1982, which Disney saw as a failure. It declined to make a sequel or any other films using Tron's techniques. But a sequel would finally come in 2010 in the form of Tron: Legacy.

Various studios turned down the film, until Lisberger finally approached Disney, which financed a test-reel using the proposed techniques. Impressed, Disney's executives funded the feature. But animators at Disney refused to work with the untraditional techniques used in the production of the film, feeling threatened by them.

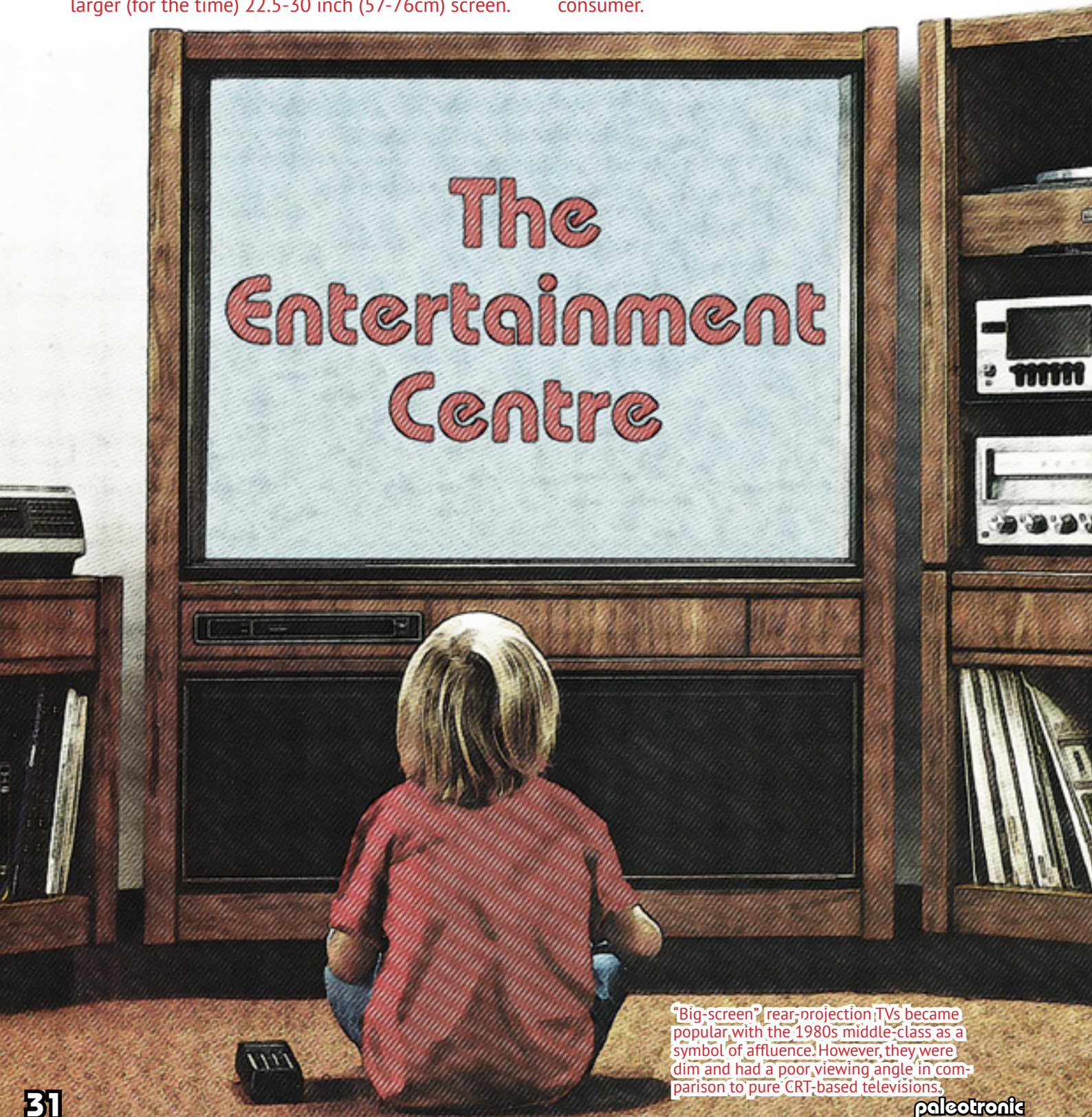


All kinds of television sets

have graced lounge and living rooms throughout the world over the last ninety years, of all shapes and sizes. Let's take a look back at some more interesting and notable models...

The rear-projection television became common in the 1970s but actually first appeared in the late 1940s when picture tubes were still quite small. An extremely bright picture was created by driving a 3-5 inch (8-13cm) CRT at a very high voltage, then mirrors and lenses were used to project the image on to a much larger (for the time) 22.5-30 inch (57-76cm) screen.

However the CRT's lifespan was shortened by the high voltages, and the availability of larger picture tubes caused projection TVs to fall out of favour until the 1970s when advances in and the falling cost of electronics made a colour rear-projection TV both practical and within the reach of the contemporary consumer.



"Big-screen" rear-projection TVs became popular with the 1980s middle-class as a symbol of affluence. However, they were dim and had a poor viewing angle in comparison to pure CRT-based televisions.



1936

The Marconi 702 had a toggle switch that allowed viewers to watch both Baird and Marconi broadcasts, but it was not an inexpensive piece of kit – it cost £60, the equivalent of £4,000 today or US\$5700. Ouch!

One of the original televisions offered for sale at the start of UK television service in 1936, the Marconi model 702 had such a long cathode-ray tube that it needed to be stood on end, and used a mirror to reflect the screen at viewers.

Clever marketing sold this deficiency as a feature, claiming that the vertical orientation protected viewers from being showered with glass if the picture tube inadvertently “exploded” (CRTs actually implode when shattered, due to the vacuum inside) and that viewing via a mirror protected their eyes from damage from the “harmful” electrons!

The CRT is masked by an overlay to crop the viewing area rectangular in shape, and make the experience more familiar to viewers used to the screen at the cinema. Over the next few years methods were developed to make the tubes less elongated, and by the end of the 1930s television sets with horizontally oriented CRTs became available.



At a price of £45 (£3,000 in 2018) this model was a bit cheaper but still very much a luxury item. It had a front-facing tube but it seems to be smaller than the one in the Marconi.

At the launch of US television service in 1939, the Andrea 1F5 was one of the first receivers available to Americans. It was available fully assembled or as a kit, and launched at a price of US\$137.50 (US\$2400 in 2018) – not as pricey as the Marconi, but still not cheap.

It used a 7 inch (18cm) in diameter RCA 7JP4 round picture tube like the one shown here – once cropped, you weren’t left with much of a screen! After television manufacturing resumed at the end of the second World War, some manufacturers (particularly Zenith) decided the circular shape of the tube wasn’t a bug but a feature, and began marketing “porthole” TVs that had the entire face of the tube exposed.



1939

With round picture tubes, the size of the screen is described in terms of the tube’s diameter, which could be determined in television sets with cropping overlays by measuring from the top-left to bottom-right corners. When rectangular tubes were introduced, this convention stuck.



1951 Zenith Television has the Amazing Reflection-Proof Blaxide Tube



However, despite concerted efforts to accustom them to the idea of a round screen, consumers found them strange (like something out of a science-fiction serial!) and manufacturers continued to press for the development of a rectangular picture tube. By 1950 one was successfully produced, and several manufacturers that year released new models that used it.

The new tube was black-and-white only though! Colour picture tubes (with their three electron guns) were much more complicated and, due to practical issues involving the convergence of colours at the corners of a rectangular tube, they would remain round until well into the 1960s.

Viewers couldn’t get used to the idea of watching a television that looked like it came out of a movie serial like Flash Gordon –who could blame them? (Could you imagine watching television on a screen like that?)

The porthole television was quickly deep-sixed once the manufacturing of rectangular picture tubes geared up and the price came down.



1950

[illegible]

As televisions got lighter, manufacturers did away with the cabinet design entirely, producing televisions that were meant to sit on other furniture and not the floor, bringing in the age of the entertainment centre. The old mechanical channel dial was replaced by electronic tuning, which in turn made remote control (first wired and then wireless) possible, and bringing the phrase “channel surfing” (to idly flip through channels, not settling on any one program for long) into the modern lexicon.

The rapidly falling cost of portable televisions soon meant the lounge room wasn't the only place you could watch TV. Televisions became common fixtures in bedrooms, dens, kitchens and basement "rumpus rooms", often relocated living-room sets, displaced by a newer model. Plastic replaced wood, and as the weight of the electronics inside the television set went down, the size of the CRT they powered went up. The lengths of the tubes became shorter while their faces became flatter, ever-more sophisticated electronic techniques making images crisper and more vibrant, the wood-grain finish vanishing to be replaced with simple black or silver, the intent for the television to also vanish from the mind of the viewer, leaving only the program they watched, immersing themselves in it.

Most major manufacturers ended CRT TV production by 2012.



Zenith were pioneers in wireless remote controls, developing the first practical system, the "Space Command" in 1956. This remote control mechanically generated ultrasonic sounds the TV interpreted as commands. However, a noticeable clicking sound was heard when buttons were pressed, leading to the remote being nicknamed the "clicker".



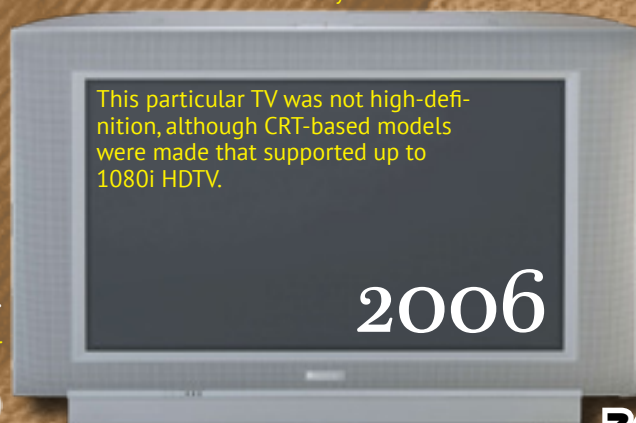
Although Westinghouse developed a rectangular colour picture tube in 1955, it took ten years before they were good enough to be mass-produced, first by Motorola.



As the miniaturisation of electronics marched on, portable TVs took the television out of the lounge/living room to wherever you wanted it to be, from the kitchen, to the back shed, to the camper/caravan.

PHILIPS

This 2006 television manufactured by Dutch company Philips featured a 29 in (74 cm) flat widescreen CRT. It doubled the normal 50hz PAL frame-rate by digitally interpolating intervening frames. It also came with a Dolby surround-sound decoder.





Telephone Television

The "Space Phone" built into some Zenith System 3 TVs from the 1970s to the 1990s unfortunately didn't let you call space, but it did let grandma call her grandkids without having to get up out of her easy chair. She could dial the number (or answer an incoming call) using the remote control, and then use the TV like a speaker phone, all while still watching *The Price Is Right* (albeit without sound).

ZENITH SYSTEM 3

Rumours from the early 1980s suggested that what Zenith really wanted to offer in their high-end televisions was video calling – this was not a new idea, as the clipping from 1936 below can attest. The pairing of television and telephone was obvious – George Orwell played on the sinister implications of such a matchup in his dystopian-future novel *1984* (written in 1948), although proponents of the technology hoped it would bring people closer together rather than facilitate the rise of a totalitarian dictatorship!

Ironically the first publicly-available "videophone" service to ever exist was in Nazi Germany. From 1936

to 1940, residents of certain German cities could go down to their local post office and sit in a video-calling booth to visit with other people in similar booths in other post offices in other cities. The booth used a flying-spot scanner to generate a video image, and had an 8-inch (20cm) 150-line CRT to display the image coming from the other end, which was sent over broadband coaxial cables linking the cities – over 1000km of them at the system's peak.

However, after the start of World War II, the videophone service was quickly decommissioned, the cables re-purposed for telegraph and television signals.

After the war, American telephone giant AT&T took up the mantle, developing a system capable of sending an image over two standard telephone line every two seconds. However, AT&T severely overpriced the service, and it never took off.

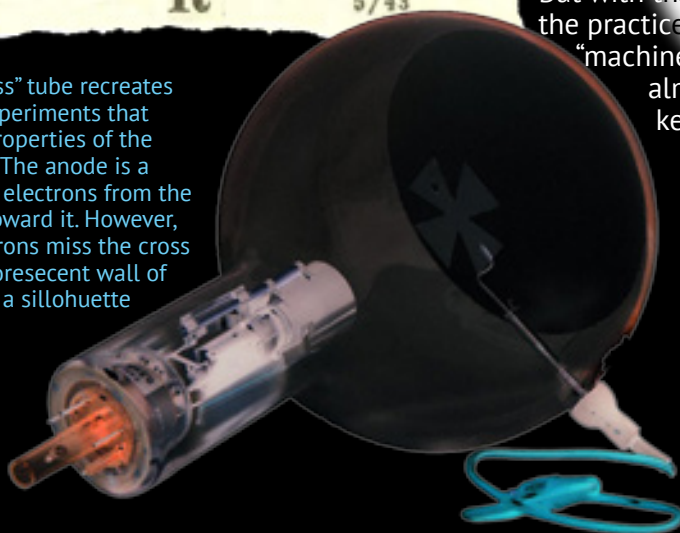
It wouldn't be until the widespread availability of broadband Internet service and modern computer processors capable of advanced video compression that videocalling would become truly practical, with services such as Skype finally making it possible for the average person to talk face-to-face, anytime and (almost) anywhere.

But with that great power also comes big questions – the practice of "data mining" conversations for "machine learning" makes the issue of privacy almost abstract. Can we trust a computer to keep our secrets? Maybe Orwell was right!

In Germany great progress is being made in telephone-television. The first line, which has been in successful operation between Berlin and Leipzig for some time, is now to be extended to Hamburg on one end and to Munich on the other end. The whole 620 miles of television cable will be ready early in 1937. A very authentic, although small, image of the person at one end of the cable may be witnessed by the person telephoning at the other end of the cable . . .

RADIO GUIDE
5/43

This "Maltese Cross" tube recreates one of the first experiments that determined the properties of the cathode-ray tube. The anode is a cut-out cross, and electrons from the cathode stream toward it. However, some of the electrons miss the cross and strike the fluorescent wall of the tube, creating a silhouette of the cross.



Crystal Ball
CRT
paleoTronic

The design of the entire optical system—which is shown in Fig. 5, and which consists of cathode ray tube, reflecting mirror, and corrector plate—is controlled by the cathode ray tube. For good focus over the entire picture area it is essential that the curve of the mirror be concentric with the curve of the tube face, and that the tube face be located approximately at the focal point of the mirror. The system has a focal length equal to the radius of curvature of the tube face.

These optical qualifications result in a fixed focal length and a single value of magnification for any chosen throw distance. Thus picture size at a fixed throw distance can be changed only by changing the size of the picture on the cathode ray tube. This may result in clipped pictures or poor resolution, but a variation of about 10 per cent either way in picture dimension is feasible. The preferred throw distance of the Simplex system is 42 feet, providing a picture 15 feet high by 20 feet wide.

Audio Engineering
January 1952



Fig. 5. The Optical Barrel for use with direct projection from TV receiver.

Paramount also led the way in another abortive venture of the early 1950s: theatre television. Exclusive broadcasts were relayed onto cinema screens, with major sporting events the main attraction.

Sony Watchman

Tiny TV's

There's been a great deal of interest in small-sized TV and this year the first commercial flat screen (or pocket) TV's may become available. Sony's 2-inch diagonal screen



POCKET-SIZED TELEVISION, such as the Sony Watchman shown here, may finally become available this year.

Watchman uses a new picture tube design which places the electron gun below and parallel to the screen surface. The scanning electron beam is magnetically "bent" to hit the screen at a perpendicular; the result is a TV only 1 1/4 inches thick. The estimated retail for that set is around \$300.

Radio Electronics
December 1982

Theatre Television

It didn't take long after the start of live television broadcasts in the United States for cinema-owners to get the idea that showing televised events could assist in lining their pockets, and film projector companies attempted to oblige, coming up with two different solutions. The first was similar to the Baird company's telecine device – except that instead of filming a subject and then scanning the film for television, it filmed a television, developed the film and then projected it.

The resultant film copy was promoted as an advantage – theatre owners could show the event again later, but there weren't many people who wanted to watch a live event, well, not live, and besides, filmed highlights were sure to appear in the following evening's newsreel. The machinery itself was also quite temperamental.

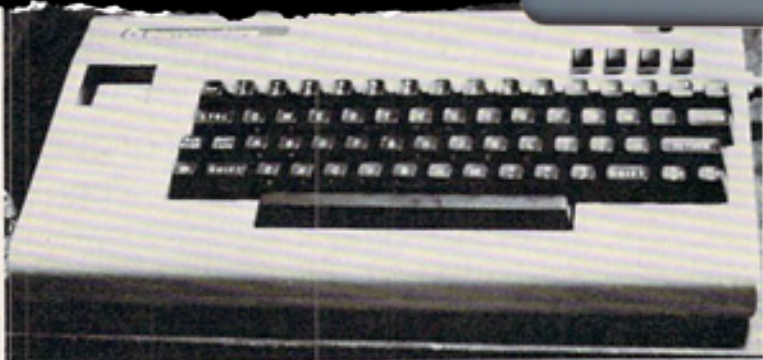
The second solution, shown left, was a "television cannon" which housed a powerful CRT that could blast a 15 ft (5m) by 20ft (7m) image on to a cinema screen. But the tubes were expensive and didn't last long, and by the end of the 1950s the idea was abandoned.

It wouldn't really return until the early 2000s, when digital projectors made showing pay-per-view events in cinemas a common practice.

First introduced in 1982, the original Sony Watchman used a curved screen "scanned" by an electron gun mounted beneath it, allowing for a portable radio-style form-factor containing all the parts needed for a miniature black-and-white television.

However at US\$750 in 2018 terms, the luxury of being able to watch television anywhere did not come cheap! Despite the high price, Sony established that there was a market for it, and subsequently released more than 65 different models between 1982 and 2000, switching to LCD screens in the early 1990s.

The first Watchman inspired the imaginations of some Commodore engineers, leading them to create this prototype "portable" VIC-20 pictured below. It never made it to production.



Experimental prototype of a VIC-20 with built-in Sony Watchman TV (upper left). Note that the keyboard has been shifted right to make room for the TV, and the four function keys have been displaced to the top. Commodore says this working prototype is only "an example of what could be done, not what will be done."

VECTOR

The Rise — and Fall? —



ROBERTO VITTI/RETNA



SHANE ANDERSON/RETNA

to simultaneously battle each other in space, with ships looking very much like the Starship Enterprise and the enemy seen as its mirror image. The game followed in a new set of controls, like the thrust and fire modes and the view-rotator (hyper-space) option. Previous games had fewer controls (usually one or two). Computerized vector games were also one of the few games that didn't

A vector graphics, a display in the arcade as well as home videogame, the vector system is a 3D image of an object in space, as velocity and acceleration. But given the same question to a videogame and the answer will be the same. A number of graphics that show objects in space.

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While the more traditional vector graphics are still more widely used in arcade and home games, there are plenty of advantages to using vector

graphics. For one thing, vector makes it easy to draw things in space, and color resolution is especially easy. Vector graphics systems have their drawbacks as well. It's just about impossible to produce real-time images due to the lack of shading and large areas are often lost to the lack of detail. However, vector's biggest drawback is its complete lack of text or image memory. (The home vector graphics system, the Intertec, actually does this, but other gaming machines with computer memory.)

When Commodore's Space Wars arrived in arcades in 1978, the vector videogame market was given a boost by the machine's novel technology. Using a computer, vector of Space Wars, is a vector control with having vector control graphics. The later Commodore 64 was a computer called Vectorware.)

Space Wars was an imaginative, original game with its basis in a game created in 1962 by computer scientists at MIT. The game allowed two players



GRAPHICS

of a Controversial Display Technique

use a timer. Big Giff, Aster Attack, and more. The same company also built the rights to Space Wars, the first home to arcade game from Giff's vector system and one of the few full-color vector graphics games in the arcade.

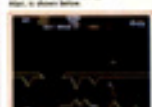
At Sega, now a subsidiary of Atari, Midway, were to be identified by one word: Star Wars. Sega's first video game, Star Wars, was a vector graphics game. The rest of the games in the series were also vector graphics games. The rest of the games in the series were also vector graphics games.

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SHANE ANDERSON/RETNA



Whereas modern computer and video-game displays use raster-based graphics, where an object is made up of an array of different coloured points of light (pixels) that is rendered sequentially along with the entire screen, a vector display instead arbitrarily moves the electron beam to render each object's outline independently.

In the 1970s, pixel-based displays often required as much memory to map the screen as the computer they were connected to. Vector displays did not have this issue as they only needed to use as much memory necessary to define the objects displayed. The resolution of the objects was also much higher, since the electron gun moved smoothly from one point to the next. But vector displays weren't great for text, colour or photorealistic images, and once

memory prices started to come down and pixel-based displays became more practical, they were gradually abandoned.

From the Computer Lab to the Arcade: The Journey of Space Wars!

Paul Monopoli takes a look back at the very first video game, and its influence on what would become one of the world's most popular pasttimes.

In 1961 the Massachusetts Institute of Technology was to receive the next advancement in computer technology. Already home to the monstrous TX-0 computer, its successor, the PDP-1 was a more compact machine, capable of everything the TX-0 could do and more. Both computers sat side by side

in the institute's computer lab, but enthusiasts tended to gravitate to the newer technology of the PDP-1.

Prior to the arrival of this new advancement in technology, the institute needed to look at what they would do with it. A small committee was formed to consider their

options, and what could be done to show off the hardware. It was Dartmouth graduate Steve Russell who came up with the answer.

Russell, known as 'Slug' for reasons that are unclear to him, came up with the concept of a piece of software that would push the technology to its limits, and be of interest to casual onlookers. Steve was a fan of science fiction and space was the hot topic of the day. With the US aiming their sights to the sky it seemed like a natural choice for their first video game.

First manufactured in 1959, Digital Equipment Corporation (DEC)'s PDP-1 (Programmed Data Processor-1) was based on MIT's TX-0 (Transistorised Experimental Computer Zero, but known as Tixo). Built over 1955-56, Tixo had a huge amount of memory (64K!) for the time, while fitting inside a reasonably-sized room.

MIT ran into difficulty building a successor to Tixo when several of the members on that team left to start DEC, whose first major commercial product was the PDP-1. They donated the prototype to MIT.

The PDP-1 was the first commercial computer to allow for dynamic interactivity from the user, rather than just processing data in batches. It came with a 2-colour paper terminal based on an IBM electric typewriter, which could be used for providing input as well as output, allowing for the editing of data (which was otherwise difficult, since it was stored on punched paper tape.)



Type 30 display

Arcade Rats

groovy video games



Before development on the game could begin Steve led his committee through the process of designing what was already known as 'Spacewar'. It was decided that the game would involve two space ships known as 'The Needle' and 'The Wedge', battling among the stars. Death would come to those who were hit by their opponent's missile or one of the surrounding stars. The centre of the game screen featured a gravity well that the ships could use to manoeuvre themselves to escape potential death. Those who found themselves in an inescapable situation could use the hyperspace button to make

their ship disappear and reappear at a random part of the screen.

With the rules in place Steve led his team through the arduous task of coding the game. As the PDP-1 was a bare bones computer with few commands available, hackers converted and improved some of the existing code from the TX-0 to avoid having to completely start from scratch. With a set of commands ready to go and a paper tape (the media used by the PDP-1) full of the math routines needed it was ready to begin working on graphics.

The TX-0 was already home to

several graphical applications, that while crude by today's standards were impressive for the time. Bouncing Ball was a simple dot that bounced up and down, making a noise as the dot hit the ground. This led the way for a Tic Tac Toe simulator, Mouse in the Maze and HAX, which all used different styles of graphics.

According to an interview in Creative Computing August 1981 Steve claims that increasing the size of the graphics from a dot to a ship was relatively easy. The outline of each ship starts at the tip and using directional codes the outline is created. These codes

In addition, the PDP-1 supported a video display, the Type 30 (shown on previous page), which was a hybrid between vector and raster displays called a "dot plotter". The electron beam was programatically moved to any position on a 1024x1024 grid and fired, creating a dot. Spacewar was developed using the Type 30.



VECTOR GRAPHICS

vector-graphics, the vector graphics haven't been completely ignored. In 1970, *Spacewar!* became the first most popular game, at least partly because of its novel vector graphics, but also because of its two-player control scheme. In the game, the user is a player.

VECTOR AT HOME AND IN THE ARCADES
The following is a partial list of the best vector graphics have ever appeared in a video game.

Game	Year	Platform
<i>Spacewar!</i>	1962	PDP-1
<i>Star Wars</i>	1983	Atari 2600
<i>Star Wars: The Force Unleashed</i>	2008	Wii
<i>Star Wars: The Force Unleashed II</i>	2010	Wii
<i>Star Wars: The Force Unleashed III</i>	2012	Wii
<i>Star Wars: The Force Unleashed IV</i>	2014	Wii
<i>Star Wars: The Force Unleashed V</i>	2016	Wii
<i>Star Wars: The Force Unleashed VI</i>	2018	Wii

The *Star Wars* franchise has been a major force in the video game industry, and the *Star Wars* franchise has been a major force in the video game industry. The *Star Wars* franchise has been a major force in the video game industry, and the *Star Wars* franchise has been a major force in the video game industry.

VECTOR VS. RASTER

The diagram illustrates the difference between vector and raster graphics. Vector graphics are made of lines, while raster graphics are made of pixels.

Space War, continued...



Figure 3. The "CBS Opening." The ships turn slightly away from the star and fire a short rocket blast (note the needle-ship's exhaust) to get into a comet-type orbit, then rotate the other way to try shooting torpedoes at the opponent.

Spacewar was exemplary of the nascent "hacker culture" that the PDP-1 spawned at MIT. Computers were no longer mere tools to be used for calculations, but were an end to themselves, their potential to be explored and their limits tested in whatever way inspired its programmers imaginations. This led to the creation of the first word processor, practical chess program and even the generation of early computer music.

But with the good also came the bad – malicious actors used the PDP-1 to find outside lines they could use to make free long-distance phone calls. They also used it to sequentially dial numbers in an effort to find other computers, whose only security was the obscurity of their telephone numbers! They also played pranks, such as attempting to tie up all the phone lines of rival university, Harvard.

In Spacewar, two ships do battle around a star, which exerts gravity on them. Each player can rotate their ship, fire missiles, apply thrusters and, in an emergency, "jump to hyperspace" which repositions their ship at a random location elsewhere on the screen (but half the time causes the ship to explode).

The gravity effect is quite pronounced and the missiles move quite slowly, meaning that to win, a player must learn the game mechanics sufficiently to predict the eventual location of their enemy.

The missiles, however, are not affected by gravity, as there wasn't enough computing power left to calculate their trajectories!

The game was initially controlled by switches on the PDP-1 console, but this was awkward (especially for one player) and an early "gamepad" was devised to eliminate this disadvantage. Spacewar would inspire a number of later games, including Computer Space and Asteroids.



You can play an emulated version of Spacewar! at <http://www.masswerk.at/spacewar/>

adjust depending on the direction the ship is facing, and pre-planning in the code helped to determine the next step. If the tip of the spaceship points downwards the directional codes would determine five possible adjacent dots that could be displayed next.

While the team wrestled with the mechanics of the game, earlier code was used where possible. A graphical demo called 'Minskytron' contained code that was used to help the ships orbit around the centre point. Even with this advantage the team struggled to map these orbits to the player's controls.

While it was a technical marvel at the time, Steve found the methods used too constricting. As a means of rotating the whole grid he added a sine and cosine to the existing code, cutting down the calculations needed for each display frame. There was provision for different shapes to be used in the code, but the game would slow down for each new item added.

Upon release the game became so addictive that the university had to impose restrictions on when the game could be played. This level of success didn't prevent up and coming coders from making their own modifications to the game. The game spread across to other PDP-1 computers at other universities, with students modifying it in ways that they felt would improve the gameplay. Most of the original development team parted ways shortly after the game was complete but their mark on the world had been made. While video games were

still far from being a cultural phenomenon, the way they captivate an audience and draw them in had been noticed by those who played Spacewar.

It is said that imitation is the sincerest form of flattery, though there are plenty of lawsuits that would argue this. With no legal protection in place many others attempted to replicate the success of Spacewar by releasing their own versions of the game. Nolan Bushnell, who was a fan of the game, developed 'Computer Space', the first commercial version of the Spacewar. However, it was Larry Rosenthal who would introduce the gaming world to real vector graphics in his own attempt to bring the game to the masses.

Larry had seen Spacewar at MIT and knew that he had to own the game. He based his Masters thesis on developing a simple, cheap hardware platform that could run the game, and even improve upon it. Using off the shelf parts Larry successfully created his clone using a custom TTL processor. The way in which Larry decided to do the graphics was very different to the earlier raster based Spacewar.

Other Spacewar clones had all used a method of turning pixels on and off to create the illusion of the spaceship moving through space. The process was slow and clunky, and Larry knew he could find a more efficient way of making it work. Using a vector beam to draw graphics, Larry used complete lines to create polygons which formed the shape of the ships. The vector graphics used a start and end point

which would define where the lines were drawn on the screen. Other points can be used along those lines to create curves. Where the code for Spacewar would tell the computer where to put each pixel on a grid, the vector graphics used in Space Wars described how the image was to be drawn and the computer would follow the instructions given.

Unlike Spacewar, Larry's game allowed for variations in gameplay. The amount of ammunition, the speed of the spaceships and the level of gravitational intensity could all be modified depending on the needs of the operator. The game contained no artificial intelligence, and as a result was two player only.

The prototype was coded on a 16 button keyboard and fit into a suitcase. With the hardware developed Larry felt it was good enough to be released to the public, so he set about carrying his suitcase to various offices. Atari were a forward thinking company who saw a future in video games, so they were approached. Larry spoke to Nolan Bushnell who quickly turned him down. Nolan's own Spacewar clone, Computer Space, had not been the big big success story that Atari were looking for. Perhaps feeling sore from that experience or not seeing the benefit of having another clone on the market he passed on the project.

Larry found hope in Cinematronics Incorporated. Founded in 1975 by Jim Pearce, Dennis Parte and Gary Garrison the business was created to cash in on the success of the arcade market. Atari had set the stan-

dard with heavy hitters like Pong, and Cinematronics were looking for their own success story. In Larry they saw the success they so strongly craved, but Larry had a price. He wanted to retain full ownership of the game and 50% of the profits (though Larry himself rejects that it was that much). Cinematronics were still relatively new on the scene and were far from the success story Atari had become. They agreed to Larry's demands and Space Wars went into production.

Initially Space Wars was released in two different cabinets. The most common release was an upright cabinet with light up marquee, which could often be found in the corner of a pub or club. Cinematronics also released a tabletop version of the game, with each player sitting on either side of the table. The game featured timed rounds, with the winner being the player who delivers the most kills in the time limit.

Larry was riding high on the wave of success, and was making good money out of his creation. However, for the electronics whiz it wasn't enough and he approached Cinematronics for more money. When they refused he decided to leave and setup a new business called Vectorbeam. As Larry still owned the rights to Space Wars Vectorbeam were also able to release the game alongside Cinematronics. Larry created his own smaller version of the cabinet with a superior screen and better quality shell.

Cinematronics were in a difficult situation. Not only had Larry left the business, but he had also

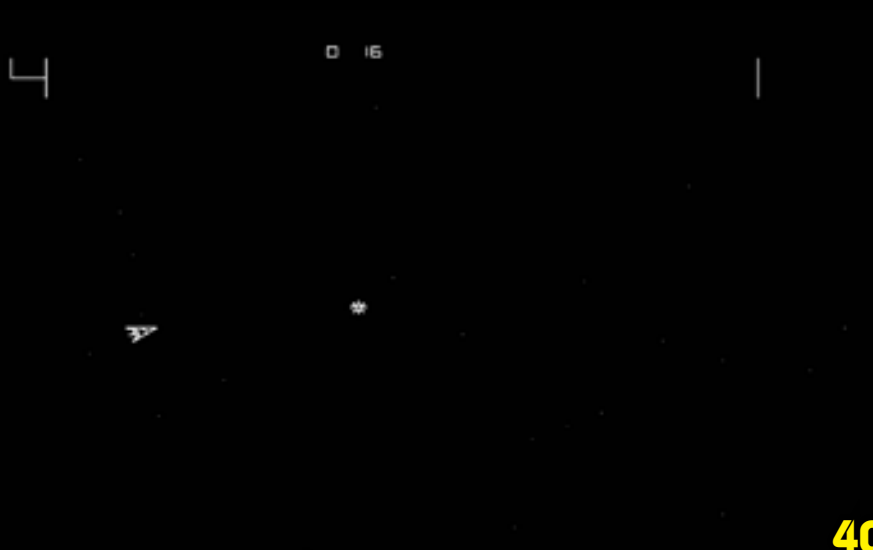


(Left) Larry Rosenthal shows off his Space Wars suitcase prototype in this 2014 photograph by Michael Dunn. It's much smaller than a PDP-1!

(Right) A Space Wars arcade cabinet, with the various button controls at the bottom. Like Pong it required two players.

(Lower-Left) A close up of Rosenthal's prototype, showing the keypad controls in the upper left.

(Lower-Right) A screenshot from Space Wars. The star present in Spacewar could be turned off.



taken the only set of instructions for programming the CPU. No copies had ever been made, and Cinematronics were forced to reverse engineer the hardware before they could resume production. The bigger problem was that as per the original agreement they were obligated to keep paying Larry royalties for each machine they released. Deciding to seek retribution, Cinematronics took Larry to court.

The matter was resolved out of court, and Larry was rumoured to be paid around \$1 million for Vectorbeam and the rights to the hardware design. Cinematronics were now the only developers of Space Wars, and they continued to use vector graphics in other arcade releases. However, all of this activity was being observed by their closest competitor. A competitor who had earlier turned down Larry Rosenthal as he was shopping around for a distributor.

In 1978 Atari was now in the hands of Warner Communications, though Nolan Bushnell was still with the company. After seeing the success of Space Wars, Warner pushed Atari designers to develop games using vector graphics. Howard Delman pitched an idea for a game that required you to land a lunar landing module on the moon. The concept was hardly new idea, but using vector graphics similar to those found in Space Wars and with the Atari name behind it this version was set to be a success.

Delman worked on the game with new Atari recruit, Rich Moore. Rich was a keen space enthusiast, having built models of lunar landing modules which he was younger. Howard was already aware at an earlier attempt at a similar landing game from 1969 called Moonlander, which itself used a vector display and a lightpen as a control method. Taking inspiration from this earlier title, as well as their own ideas the duo started work out of Grass Valley in 1978 after spending time experimenting with vector graphics.



Howard already had a reputation as a jack-of-all-trades coder, and paired with Rich it was thought that the game could never be anything short than a success. Rich planned the game on graph paper, which he had to buy himself as Atari did not have any in stock. He used a paper and pencil method to plan the vectors, setting up the mountains using only his memory of the 1969 game as reference. Rich was ambitious, wanting craters to be left on the surface when a ship crashed. Unfortunately this would have added more lines to the graphical display, increasing the refresh rates and slowing the game down.

Rich's paper and pen graphics were converted into code, which was then entered in by two ladies who were fast typists. This code would be compiled and tested before revisions were made. The game was eventually released in an upright cabinet. A cocktail version was planned, though only two prototypes were made before the idea was cancelled.

Lunar Lander was released in 1979, though it was never able to achieve the level of success it arguably deserved due to Atari themselves releasing another addictive new title.

Ed Logg had previously encountered a four player version of Spacewar while at Stanford, and while he claims to have been beaten in every game he played, the ideas that the game introduced stayed with him. After getting his big break at Atari and releasing Super Breakout, senior executive and avid gamer Lyle Rains called Ed into his office to discuss a future project.

Lyle wanted to update a classic game that he struggled to remember the name of, though in recent interviews claims that it may have been Computer Space. He liked the idea of asteroids being a part of the playing field and thought that the idea of blowing them up could be interesting. The concept was simple, though Ed and Lyle clashed over the way to present the game. Ed pushed to develop the game using vector graphics, though Lyle was keen to use raster. At the time vector technology allowed the use of higher resolutions and Ed was keen to experiment with it. Lyle suggested that Ed look at the project as a creative exercise rather than as a game. Ed began his project in earnest.

Howard Delman was already working with Rich Moore on Lunar Lander, and Ed came on board to work on the scoring system and the on screen text. This gave Ed an introduction to working with vector graphics, and how to plan, prepare and present them. Similar to Rich Moore's graph paper approach, Ed worked his designs on paper before taking them to the computer. His designs appear to be less precise than those created by Rich for Lunar Lander, but Ed was able to successfully transfer his designs into the system and begin experimenting with the game.

Ed started to develop player strategies for the game after he could see the graphics moving back and forth. He considered the ways that gamers would play the game and developed challenges around them, including the saucer. Hardware limitations meant that Ed was unable to include two saucers in the game, but he was happy to have one there to torment players. Perhaps taking inspiration from Spacewar, a hyperspace button was introduced to teleport you to a random part of the screen in moments of desperation.



©1979 ATARI INC



Ed started to realise the game was a potential hit when Atari staff would ask him when he was leaving for the day so they could play the game. Lyle was so excited that he arranged a focus group for Asteroids. Ed sat behind a one way mirror and wrote down feedback from the players in the room. The sound effects, created by Howard Delman, were rated highly as they created a feeling of tension, keeping the players on edge. When released the game earned Atari over \$600 million in sales and gameplay revenue, eclipsing the three month old Lunar Lander.

Though a success, the hardware did have some issues with the vector display. A bug in the game can cause the vector beam to burn a hole in the screen, though it is unlikely that the casual gamer will ever encounter this. After Asteroids Ed never worked with vector hardware again, feeling like he had achieved his goal and wanting a new challenge.

Vector graphics were all the rage in the late 70s, though by the 80s interest had started to fade. While newer games, such as Vector Racing on Nintendo 3DS attempt to keep the spirit of vector graphics alive they are really only seen as a novelty. Today Spacewar, Asteroids and Lunar Landers are seen as relics from the golden age of gaming, with gamers today preferring realistic visuals and as many colours as a screen can handle.

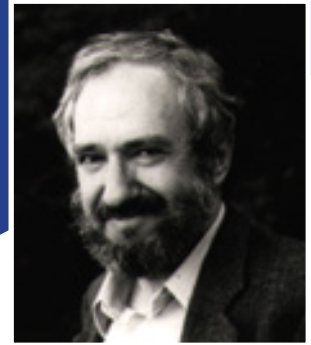
97310
AAAAAA

ANCIENT TONGUES

```
to mainloop
  ht
  shrinktails
  checkthings
  movethings
  frame
  wait 1
  make "cyclecount :cyclecount - 1
  if :cyclecount > 0 [ mainloop ]
  finishgame
end
```

The main game **loop**. It calls a number of other **procedures** that contain the game's mechanics.

You can duke it out with a friend, but be careful not to fall into the star in this exclusive Spacewar clone written in Apple Logo.



```
to start :cycles
  make "cyclecount :cycles
  make "p1score 0
  make "p2score 0
  resetlevel
  mainloop
end
```

Start the game! This procedure takes a **value** declaring the game's length.

The two **addscore** routines below also take a value, in this case the amount to add to each player's respective score.



```
to addscorep1 :amt
  make "p1score :p1score + :amt
  make "scoreupdate 1
end
```

```
to addscorep2 :amt
  make "p2score :p2score + :amt
  make "scoreupdate 1
end
```

```
to drawscores
  if :scoreupdate = 0 [stop]
  cleartext
  setcursor list 10 20
  pr "p1
  setcursor list 30 20
  pr "p2
  setcursor list 10 21
  pr :p1score
  setcursor list 30 21
  pr :p2score
  make "scoreupdate 0
end
```

```
to drawtimer
  setcursor list 17 22
  local "sp make "sp char 32
  pr se "TIME :cyclecount :sp
end
```

```
to resetp1
  local "r make "r 60 + random 20
  local "a1 make "a1 random 360
  make "p1x :r * sin :a1
  make "p1y :r * cos :a1
  make "p1h :a1 + 90
  make "p1tx 0
  make "p1ty 0
  make "p1tc 0
end
```

Seymour Papert's (above-right) **Logo** programming language is perfect for a game like **Spacewar** – **Logo** uses vectors to draw graphics, unlike **BASIC** which typically plots pixels based on precise screen co-ordinates.

Rather than saying **PLOT 50,100; PLOT 50,101** etc., **Logo's turtle** occupies a certain position in **Logo** "space", and can be moved relative to that position by using commands such as **fd** (forward), **rt** (right turn) and so forth.

By specifying whether the turtle's "pen" (held in its tail) is up or down, it can draw a trail behind it as it moves, and this is how **Spacewar** renders its graphic elements.

In **Logo Spacewar** there are two ships, each of which can rotate left or right, thrust forward or in reverse, fire a missile, or jump to **hyperspace** (move to a random location on the screen – although sometimes it causes your ship to explode!) There's also a star at the centre of the playfield that has a **gravitational influence** on the players and their missiles – crashing into it is fatal!

Once all of the code on these four pages is entered (don't forget to **save "spacewar"**) you start the game by calling the start procedure along with a game length, for example **start 1000**. The game will begin and a timer will start counting down from the number you specified, in this case 1000. The player with the most amount of points when the timer runs out wins!

Player one controls their ship with the up, down, left and right arrows, and the comma and period keys for hyperspace and fire respectively. **Player two** uses D, X, Z and C, and Q and W.

```
to resetlevel
  make "hypersuccess 70
  make "missilelife 50
  make "gravitystrength 2
  make "thrust 0.3
  make "turn 10
```

```
make "p1x -30
make "p1y 30
make "p1h 45
make "p1size 2
make "p1tx 0
make "p1ty 0
make "p1tc 0
make "p1gx 0
make "p1gy 0
```

```
make "p2x 30
make "p2y -30
make "p2h 275
make "p2size 2
make "p2tx 0
make "p2ty 0
make "p2tc 0
make "p2gx 0
make "p2gy 0
```

The **resetlevel** procedure declares all of the variables used in the game, and sets default values for constants, such as the ships' thrust and the strength of the star's gravity..

```
make "m1x 0
make "m1y 0
make "m1h 0
make "m1tx 0
make "m1ty 0
make "m1life 0
```

```
make "m2x 0
make "m2y 0
make "m2h 0
make "m2tx 0
make "m2ty 0
make "m2life 0
```

```
make "update 1
make "px2km 20
make "gconst 2.53932807e+21
make "pixelm 1200000
```

```
make "starx 0
make "stary 0
make "stars 3
make "scoreupdate 1
```

```
resetpositions
end
```



Q: Can this run on a real Apple II?

A: Yes and no. It can run but very slowly! Use the "warp" mode in your Apple II emulator, or the Logo interpreter built-in to microm8.

```
to resetpositions
  local "r make "r 60 + random 20
  local "a1 make "a1 random 360
  local "a2 make "a2 :a1 - 180
  make "p1x :r * sin :a1
  make "p1y :r * cos :a1
  make "p2x :r * sin :a2
  make "p2y :r * cos :a2
  make "p1h :a1 + 90
  make "p2h :a2 + 90
  make "p1tx 0
  make "p1ty 0
  make "p2tx 0
  make "p2ty 0
end
```

```
to star :x :y :size :pc
  ht
  setx :x
  sety :y
  setheading random 360
  setpc :pc
  pu
  fd :size
  pd
  bk 2 * :size
  pu
  fd :size
  lt 90
  pu
  fd :size
  pd
  bk 2 * :size
  pu
end
```

```
to ship :x :y :h :size :tailsize :pc
  ht
  setpc :pc
  setheading :h
  setx :x
  sety :y
  make "a :size
  make "b :size * 2
  make "t :a * :a + :b * :b
  make "c sqrt :t
  pu
  fd :a
  pd
  lt difference 180 26.6
  fd :c
  lt difference 180 63.4
  fd :b
  lt difference 180 63.4
  fd :c
  pu
  lt difference 180 26.6
  fd :b
  if :tailsize = 0 [lt 180 stop]
  setpc 13
  pd
  fd :tailsize
  pu
  lt 180
end
```

ship requires six parameters, each of which becomes a local variable inside of the procedure. **pu** (pen up) and **pd** (pen down) control whether the turtle is drawing or not.



Unlike **BASIC**, which uses line numbers to direct program flow, **Logo** uses named **procedures** instead. Procedures contain a series of commands – such as ones to move the turtle, manipulate variables or make sounds – which fulfil the set aim of the procedure.

Procedures are declared with the command **to** followed by a unique name, and are finished with the command **end**. For example, the **resetpositions** procedure to the left, which defines the locations of the Spacewar elements at the start of the game, begins with **to resetpositions**. It is then followed by a series of commands which then do the actual work.

make is similar to the BASIC command **LET** – it assigns a value to a named variable, for example setting **p1tx** to 0. Variables can be copied to other variables, or used to calculate new values, such as in **p1h :a1 + 90** (the colon denotes that **a1** is another variable, since Logo allows you to string multiple commands on the same line, as in **local "a2 make "a2 :a1 - 180** which both declares the variable **a2** is local or only valid inside the **resetpositions** procedure, and sets **a2** to **a1-180**).

```
to movethings
  movemissile1
  movemissile2
  moveshipp2
  moveshipp1
end
```

```
to checkinputs
  checkkeys
  checkjs1
  checkjs2
end
```

```
to checkthings
  checkships
  checkmissiles
  checkplayerstar
  checkinputs
end
```

The three procedures to the left exclusively contain declarations of other procedures! As you might imagine, **Logo** programs can become very intertwined and complex.

This procedure is quite **sophisticated**. It checks to see if a missile has contacted a player (or the star, which is represented as player 3.)

```
to checkplayermissile :x :y :mx :my :size :pnum :mnum
  local "d
  make "d distance :x :y :mx :my
  if :d > 4 * :size [stop]
  star :x :y :size 13
  if :pnum = 1 [explodep1 1000]
  if :pnum = 2 [explodep2 1000]
  if :pnum = 3 [toot 2000 10]
  if :mnum = 1 [make "m1life 0 make "m1x 0 make "m1y 0]
  if :mnum = 2 [make "m2life 0 make "m2x 0 make "m2y 0]
end
```

stop forces **Logo** to exit from the procedure prematurely.

```
to missile :x :y :h :size :pc :life
  if :life = 0 [stop]
  ht
  setpc :pc
  setheading :h
  setx :x
  sety :y
  pd
  fd :size
  pu
end
```

if functions similarly to **BASIC**, evaluating two variables or values, and then executing the commands or procedures within the brackets if the statement is **true**.

```
to frame
  ht
  if :update = 0 [stop]
  make "update 0
  clean
  star :starx :stary :stars 13
  ship :p1x :p1y :p1h :p1size :p1tc 3
  ship :p2x :p2y :p2h :p2size :p2tc 5
  missile :m1x :m1y :m1h 3 14 :m1life
  missile :m2x :m2y :m2h 3 14 :m2life
  drawscores
  drawtimer
end
```

```
to firep1
  if :m1life > 0 [stop]
  make "m1life :missilelife
  make "m1tx :p1tx + 1 * sin :p1h
  make "m1ty :p1ty + 1 * cos :p1h
  make "m1x :p1x + :m1tx
  make "m1y :p1y + :m1ty
  make "m1h :p1h
end
```

```
to firep2
  if :m2life > 0 [stop]
  make "m2life :missilelife
  make "m2tx :p2tx + 1 * sin :p2h
  make "m2ty :p2ty + 1 * cos :p2h
  make "m2x :p2x + :m2tx
  make "m2y :p2y + :m2ty
  make "m2h :p2h
end
```

Because **Logo** uses procedures instead of line numbers, the procedures can be entered in any order. However, the contents of the procedures must be entered **exactly** as written!

Logo is not an acronym, but instead is derived from the greek word Logos, meaning thought.

Logo was designed in 1967 by Papert, Wally Feurzeig and Cynthia Solomon.

LOGO SPACEWAR!


```
to boosterp1 :power1 :heading1
  make "p1tx :p1tx + :power1 * sin :heading1
  make "p1ty :p1ty + :power1 * cos :heading1
  if :power1 > 0 [ make "p1tc :p1tc + 5 ]
  if :power1 < 0 [ make "p1tc :p1tc - 5 ]
  if :p1tc > 20 [ make "p1tc 20 ]
  if :p1tc < -20 [ make "p1tc -20 ]
end
```

```
to boosterp2 :power2 :heading2
  make "p2tx :p2tx + :power2 * sin :heading2
  make "p2ty :p2ty + :power2 * cos :heading2
  if :power2 > 0 [ make "p2tc :p2tc + 5 ]
  if :power2 < 0 [ make "p2tc :p2tc - 5 ]
  if :p2tc > 20 [ make "p2tc 20 ]
  if :p2tc < -20 [ make "p2tc -20 ]
end
```

```
to gravitycalc :sx :sy :x1 :y1
  local "dx
  make "dx difference :sx :x1
  local "dy
  make "dy difference :sy :y1
  local "s
  make "s :dx * :dx + :dy * :dy
  local "d
  make "d sqrt :s * :pixelm
  local "r3
  make "r3 :d * :d * :d
  local "f
  make "f :gconst / :r3
  local "t
  make "t abs :dx + abs :dy
  local "gx
  make "gx :dx / :t * :f
  local "gy
  make "gy :dy / :t * :f
  output :gx * :gravitystrength :gy * :gravitystrength
end
```

```
to explode
  toot 200 120
end
```

```
to checkplayerstar
  checkstar :p2x :p2y :p2size 2
  checkstar :p1x :p1y :p1size 1
end
```

```
to checkships
  local "d
  make "d distance :p1x :p1y :p2x :p2y
  if :d > :p1size [stop]
  star :p1x :p1y :p1size 13
  star :p2x :p2y :p2size 13
  explode
  resetpositions
end
```

```
to finishgame
  cleartext
  setcursor list 0 20
  if :p1score > :p2score [ pr [PLAYER ONE WINS] ]
  if :p2score > :p1score [ pr [PLAYER TWO WINS] ]
  if :p2score = :p1score [ pr [DRAW] ]
  pr [Type start number to start the game.]
end
```

Like BASIC, Logo uses the **if** command to make decisions regarding **program flow**. For example, in the last line within **checkjs1** to the right, **if** is used to validate the two expressions **:b > 0** and **:p1 > 245**. If both are found to be true, the program jumps to the procedure **hyperspacep1**, where player one, well, jumps to hyperspace.

When the **hyperspace** procedure **ends**, it will return back to the procedure that called it. But the **hyperspace** procedure could jump someplace else before that happens, and the **program flow** may never return back to **hyperspace** nor **checkjs1**! (There's no requirement that it should.) So, while the lack of **line numbers** or **GOTO** may seem restrictive on the surface, Logo's program flow can really be quite complex.

readchar is used to read ASCII values from the keyboard.

Each letter, number and symbol has an ASCII number from 0 to 255 (an 8-bit binary number has up to 256 combinations.) The **checkkeys** procedure to the right reads the keyboard and then compares it to a number of different ASCII values representing different keys used to control the game, rotating players' ships, thrusting, firing topedos and jumping to hyperspace.

The **paddle** function in the **checkjs** procedures toward the top of the page performs a similar utility, reading the paddle (or joystick) and its button(s) instead.

Apple Logo was explored by a large number of 1980s schoolchildren.

```
to hyperspacep2
  local "r make "r random 100
  if :r > :hypersuccess [explodep2 1000 stop]
  wormhole :p2x :p2y 10 90 14
  make "p2x random 280 - 140
  make "p2y random 192 - 96
  make "p2h random 360
  make "p2tc 0
  wormhole :p2x :p2y 10 90 14
  toot 1000 3
  toot 777 6
  toot 333 3
  toot 111 10
end
```

```
to checkjs1
  local "p0
  make "p0 paddle 0
  local "p1
  make "p1 paddle 1
  local "b
  make "b buttonp 0
  if :b = 0 and :p0 < 20 [make "p1h :p1h - :turn]
  if :b = 0 and :p0 > 245 [make "p1h :p1h + :turn]
  if :b = 0 and :p1 < 20 [ boosterp1 :thrust :p1h ]
  if :b = 0 and :p1 > 245 [ boosterp1 0 - :thrust :p1h ]
  if :b > 0 and :p1 < 245 [ firep1 ]
  if :b > 0 and :p1 > 245 [ hyperspacep1 ]
end
```

```
to checkjs2
  local "p2
  make "p2 paddle 2
  local "p3
  make "p3 paddle 3
  local "b
  make "b buttonp 1
  if :b = 0 and :p2 < 20 [make "p2h :p2h - :turn]
  if :b = 0 and :p2 > 245 [make "p2h :p2h + :turn]
  if :b = 0 and :p3 < 20 [ boosterp2 :thrust :p2h ]
  if :b = 0 and :p3 > 245 [ boosterp2 0 - :thrust :p2h ]
  if :b > 0 and :p3 < 245 [ firep2 ]
  if :b > 0 and :p3 > 245 [ hyperspacep2 ]
end
```

```
to checkkeys
  if not keyp [ stop ]
  make "code ascii readchar
  if :code = 8 [ make "p1h :p1h - :turn ]
  if :code = 21 [ make "p1h :p1h + :turn ]
  if :code = 11 [ boosterp1 :thrust :p1h ]
  if :code = 10 [ boosterp1 0 - :thrust :p1h ]
  if :code = 122 [ make "p2h :p2h - :turn ]
  if :code = 99 [ make "p2h :p2h + :turn ]
  if :code = 100 [ boosterp2 :thrust :p2h ]
  if :code = 120 [ boosterp2 0 - :thrust :p2h ]
  if :code = 44 [ hyperspacep1 ]
  if :code = 46 [ firep1 ]
  if :code = 113 [ hyperspacep2 ]
  if :code = 119 [ firep2 ]
  make "update 1
end
```

```
to checkboundsp1
  if :p1x < -140 [ make "p1x 140 stop ]
  if :p1x > 140 [ make "p1x -140 stop ]
  if :p1y < -80 [ make "p1y 80 stop ]
  if :p1y > 80 [ make "p1y -80 stop ]
end
```

```
to checkboundsp2
  if :p2x < -140 [ make "p2x 140 stop ]
  if :p2x > 140 [ make "p2x -140 stop ]
  if :p2y < -80 [ make "p2y 80 stop ]
  if :p2y > 80 [ make "p2y -80 stop ]
end
```




```

to checkstar :x :y :size :pnum
  local "d
  make "d distance :x :y :starx :stary
  if :d > 2 * :stars [stop]
  star :x :y :size 13
  if :pnum = 1 [explodep1 100]
  if :pnum = 2 [explodep2 100]
end

```

```

to checkboundsm1
  if :m1x < -140 [ make "m1x 140 stop ]
  if :m1x > 140 [ make "m1x -140 stop ]
  if :m1y < -80 [ make "m1y 80 stop ]
  if :m1y > 80 [ make "m1y -80 stop ]
end

```

```

to checkboundsm2
  if :m2x < -140 [ make "m2x 140 stop ]
  if :m2x > 140 [ make "m2x -140 stop ]
  if :m2y < -80 [ make "m2y 80 stop ]
  if :m2y > 80 [ make "m2y -80 stop ]
end

```

```

to moveshipp1
  local "gravity
  make "gravity gravitycalc :starx :stary :p1x :p1y
  make "p1tx :p1tx + first :gravity
  make "p1ty :p1ty + last :gravity
  make "p1x :p1x + :p1tx
  make "p1y :p1y + :p1ty
  checkboundsp1
  make "update 1
  if :p1tc > 0 [make "p1tc :p1tc - 1]
end

```

```

to moveshipp2
  local "gravity
  make "gravity gravitycalc :starx :stary :p2x :p2y
  make "p2tx :p2tx + first :gravity
  make "p2ty :p2ty + last :gravity
  make "p2x :p2x + :p2tx
  make "p2y :p2y + :p2ty
  checkboundsp2
  make "update 1
end

```

```

to movemissile1
  if :m1life = 0 [stop]
  make "m1life :m1life - 1
  local "gravity
  make "gravity gravitycalc :starx :stary :m1x :m1y
  make "m1tx :m1tx + first :gravity
  make "m1ty :m1ty + last :gravity
  make "m1x :m1x + :m1tx
  make "m1y :m1y + :m1ty
  checkboundsm1
  make "update 1
end

```

```

to movemissile2
  if :m2life = 0 [stop]
  make "m2life :m2life - 1
  local "gravity
  make "gravity gravitycalc :starx :stary :m2x :m2y
  make "m2tx :m2tx + first :gravity
  make "m2ty :m2ty + last :gravity
  make "m2x :m2x + :m2tx
  make "m2y :m2y + :m2ty
  checkboundsm2
  make "update 1
end

```

The **checkstar** procedure checks to see if either player has drifted too close to the star, and if they have blows them up! But if a player is moving fast enough, it is possible for this procedure to fail to detect them, and they will pass through the star unharmed. (This isn't a bug, it's a feature!)

checkmissiles1 and **checkmissiles2** determine if either player's missile is active, and if so calls other procedures which determine whether it has collided with a player or the star.

```

to checkmissiles
  checkmissiles1
  checkmissiles2
end

```

```

to checkmissiles1
  if :m1life = 0 [stop]
  if :m1life > 45 [stop]
  checkplayermissile :p1x :p1y :m1x :m1y 1 1 1
  checkplayermissile :p2x :p2y :m1x :m1y 1 2 1
  checkplayermissile :starx :stary :m1x :m1y 2 3 1
end

```

```

to checkmissiles2
  if :m2life = 0 [stop]
  if :m2life > 45 [stop]
  checkplayermissile :p1x :p1y :m2x :m2y 1 1 2
  checkplayermissile :p2x :p2y :m2x :m2y 1 2 2
  checkplayermissile :starx :stary :m2x :m2y 2 3 2
end

```

Logo is a dialect of LISP, the second-oldest high-level programming language.

Other notable **commands** used in this Logo program include:

setpc – set the colour of the turtle's pen. The number of available colours depends on the computer (real or emulated) and the version of Logo.

setx, **sety** – moves the turtle directly to a fixed X or Y co-ordinate on the screen. This is typically directly related to the video resolution of the host computer.

toot – plays a tone based on a provided note frequency and duration.

repeat – repeats a specified number of times the commands or procedures contained within the square brackets immediately following.

Notable **functions** include:

sqr – find the square root of an input

random – generate a random number between 0 and the input provided.

Next issue, we'll dive deeper into how **Logo Spacewar** works, and how we can change it. 🐢

```

to shrinktails
  if :p1tc > 0 [make "p1tc :p1tc - 1]
  if :p2tc > 0 [make "p2tc :p2tc - 1]
  if :p1tc < 0 [make "p1tc :p1tc + 1]
  if :p2tc < 0 [make "p2tc :p2tc + 1]
end

```

```

to distance :x1 :y1 :x2 :y2
  local "dx
  make "dx difference :x1 :x2
  local "dy
  make "dy difference :y1 :y2
  local "s
  make "s :dx * :dx + :dy * :dy
  local "d
  make "d sqrt :s
  output :d
end

```

```

to explodep1 :points
  star :p1x :p1y 3 13
  addscorep2 :points
  explode
  resetp1
end

```

```

to explodep2 :points
  star :p2x :p2y 3 13
  addscorep1 :points
  explode
  resetp2
end

```

```

to wormhole :x :y :max :angle :pc
  local "s make "s 1
  pu
  setx :x
  sety :y
  pd
  setpc :pc
  repeat :max [ fd :s rt :angle make "s :s + 1 ]
  pu
end

```

```

to hyperspacep1
  local "r make "r random 100
  if :r > :hypersuccess [explodep1 1000 stop]
  wormhole :p1x :p1y 10 90 14
  make "p1x random 280 - 140
  make "p1y random 192 - 96
  make "p1h random 360
  make "p1tc 0
  wormhole :p1x :p1y 10 90 14
  toot 1000 3
  toot 777 6
  toot 333 3
  toot 111 10
end

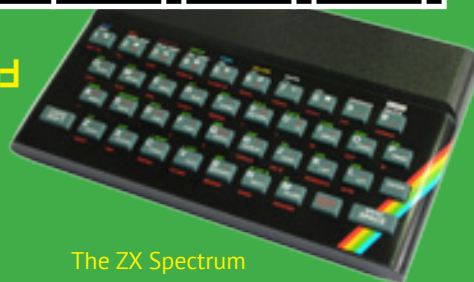
```




LOADING READY RUN!

Sinclair edition

Paleotronic newcomer David Stephenson looks back at the ingenious and quirky video circuitry inside the Sinclair ZX Spectrum.



The ZX Spectrum

April 1982 saw the launch of Sinclair Research's most successful micro-computer, the ZX Spectrum.

The Spectrum was not the first Sinclair computer to make it big, it was however the first to go massive. In the months prior to launching 'The Computer Programme' had aired on the BBC, legitimising the home micro computer as the must have educational item of the 1980's. For Sinclair and the ZX Spectrum the time was right, parents were keen, and the kids were excited. Games would soon be everywhere thanks to all the kids programming their brand new Spectrum's.

A major success factor, the one that gave the Spectrum its name is the computer's capacity to generate a spectrum of colours. The micro is capable of generating 16 colours, 8 low intensity colours and 8 matching bright variants. It's hard to imagine now, but in 1982 these 16 colours were enough to start a home computer revolution. Richard Altwasser, the engineer employed by Sinclair to develop the Spectrum's graphic systems was setting a new benchmark with some very innovative ideas.

The Spectrum's design had to come with some limitations to meet the affordable price point of £125. To this end, the original Spectrum arrived in two flavours, a base computer coming in with 16k of RAM on board; and a higher specification version with a more sizeable 48k. That 16 or 48k had to be shared between absolutely every process the computer was going to undertake, including holding of a full screen worth of data. No dedicated graphics memory for the micro computers of 1982.

Pricing constraints brought further limitations. The ZX Spectrum had no dedicated sprite generation ICs. This was in contrast to other emerging micro-computers of the period, such as the Commodore 64. The Spectrum's Z80 CPU and ULA

would do all the graphical heavy lifting. The ULA or Un-committed Logic Array is similar in function, but not in implementation to today's CPLD's where the work of many TTL logic chips is combined into one IC. The Spectrum's minimal graphics processing hardware and constrained 16k of RAM led to Altwasser's invention of an extremely efficient and somewhat esoteric display system.

The conceived design was unique, allowing Sinclair Research and Richard Altwasser to patent the implementation. The Spectrum set aside 6912 Bytes of RAM to be used for a display file and an attribute array. The display file holds 256x192 pixel data in 32x24 character blocks, taking 6144 bytes of RAM, leaving 768 bytes for the attribute array. The attribute array stores colour information for each character block. One byte per block holds foreground and background colours, plus a blink value for on or off. This is an excellent space saving solution for displaying coloured text, though slightly limiting in advanced graphics usage.

An absence of sprite hardware combined with the fact that Spectrum's display system was optimally designed to contain two colours per 8x8 character block, had ongoing ramifications for burgeoning games programmers. The most notable feature (or issue) is what has become known as 'Colour Clash'. When moving sprites with different colour information around the screen to an underlying character block, colours of either the character block or the sprite will be changed to match each other. This is the Colour Clash effect. Some form of Colour Clash can be found in just about every game produced for ZX Spectrum. It caused a graphics style that became synonymous for British Computing and Gaming of the 1980s.

Games programmers have met the challenge of Colour Clash by employing a variety of solutions. The first and easiest method has always been to move sprites around the screen in character squares, and replace any existing elements under a sprites path.

An approach that can potentially avoid the Colour Clash effect entirely. Some fantastic games shift sprites around in this manner. DK'Tronics 1982 title 'Centipede' for one. By no means a perfect conversion of the arcade game, it nevertheless manages to impress with its fast paced action. That sprites move around in character blocks is a of no real issue in the early days of home micro computing. However a pixel perfect fluid movement of sprites and other game elements soon became more important.

Perhaps the most common system employed in avoiding Colour Clash took root in some of the Spectrums' early sprite pushing classics. Matthew Smith's 1983 'Manic Miner' came close to keeping conflicting coloured games elements separated, accepting the odd colour crossovers during game play. Scenic elements are maintained in separate character blocks, with background spaces limited to solid slabs of colour. Some hiccups in colour bleeding are easily ignored when the game play is good. This technique is used throughout the Spectrum's commercial life. Later games, such as US Gold's 1987 conversion of the arcade hit 'Gauntlet', continued building on this method as it's relatively easy to implement.

If colour anomalies are expected by gamers as part of the overall experience, then why fight them? Work with them. In well crafted game worlds such as the Oliver Twins series of 'Dizzy' arcade adventures, the Spectrum's full colour palette can be seamlessly pressed into service.



The "colour clash" created by the economies used in the ZX Spectrum's graphics hardware meant the colours of the characters in the game Double Dragon changed with the colour of the background.



One way to resolve this problem was to restrict certain game areas to particular colours, such as in Paperboy, or avoid using backgrounds entirely, keeping it black wherever possible.

the zx spectrum

Launched:	23 April 1982
Price / RAM:	£125 (16K) or £175 (48K) (£425/US\$600 or £600/US\$850 in 2018)
CPU:	Z80@3.5MHz
Video:	256x192 pixels / 7 colours (15 shades)
Text Screen:	32 columns by 24 rows / 7 colours (15 shades)
Sound:	One voice / 10 octaves
Operating System:	16K Sinclair BASIC, which featured single-keystroke command entry
Keyboard:	Chiclet-style (hence the shortcuts)
Storage:	Cassette tape via Mic(rophone) and Ear(phone) 3.5mm jacks
Peripherals:	ZX Printer (4in/100mm-wide paper) ZX Interface 1 (serial / LAN) ZX Microdrive (fast tape drive) Kempston Joystick interface

Following in the footsteps of its predecessors, the low-cost ZX80/81, the Spectrum was relatively inexpensive in comparison to its contemporaries, which cost more but often provided less functionality (e.g. the Commodore VIC-20). It was wildly successful in Europe, selling 5 million units of various configurations between 1982 and 1992.





Amongst other things, Sir Clive tried his hand at creating a Watchman competitor, but 1983's TV80 was a flop, selling only 15,000 units after costing £4m to develop.

clive sinclair

Similar to the Watchman, the TV80 used a flat CRT with a side-mounted electron gun which scanned the rear of the tube.

After selling DIY radio kits and writing electronics handbooks during the late 1950s, English entrepreneur and inventor Sir Clive Marles Sinclair founded Sinclair Radionics in 1961, which subsequently produced the first slim-line electronic pocket calculator in 1972, the Sinclair Executive. Through the rest of the 1970s, Sinclair Radionics would produce a number of pocket calculators, most aimed at the low-end of the market. While the calculators were largely successful, forays into digital watches and portable televisions were not.

Sir Clive founded another company in 1973 that would eventually become Sinclair Research, which launched a microcomputer kit in 1978. Sinclair Radionics (not by that point majority-owned by Sir Clive, but the British Government as part of a social enterprise scheme) had also embarked on a computing project, the NewBrain, intended to compete with the Apple II. But Sir Clive, always looking for means to reduce the cost (and price) of his products, saw ways in which a "home" computer could be produced more cheaply.

The ZX80 was launched in 1980 and was the first fully-assembled, complete computer sold for under £100. Its successor, the ZX81, was released in 1981, and Sir Clive unveiled the Spectrum in 1982, for which he was knighted. Sir Clive sold his computer line to Amstrad in 1986, and has since worked on developing electric cars and bicycles.

Character sprites taking on the colours of background scenic elements can be just as effective as trying avoiding color issues entirely. It creates a transparency that sometimes blends them visually a little to close with other game elements. In well thought out game worlds the effects are acceptable, and even contribute to building atmosphere.


Colourfully crafted games don't necessarily require an abundance of colours. Isometric games such as those popularised by Sandy White's 1983 'Ant Attack' and Ultimate Play the Game's 'Knight Lore' form a lost genre characterised by 45 degree 3D playing arenas. In these games reduced colour choices are a necessity for maintaining continuity where sprites wander in 3D space. Isometric games were designed with multiple rooms in monochromatic palettes per location, highlighting movement through a games world without sacrificing a games vibrancy. A wider range of colours could still be used outside the main playing pane. Costa Panayi's 'Highway Encounter' from 1985 deploys colourful scenic elements around the games edges, building ambience and a feeling of in game progression. In other games such as Ultimates 1987 'Bubbler', elements such as colourful inventory and status displays effectively uplift the monochromatic experience.

But time has not stood still and neither has software development for the ZX Spectrum. In 2011 Andrew Owen, a long established Spectrum coder released the ZXodus graphics engine, al-

lowing a Spectrum to change colours at every scanline. The new 8x1 colour block definitions revolutionised the two colours per character 8x8 attribute limits. Other graphics engines have subsequently become available, the most popular to date being Einar Saukas's Nirvana+ engine.

Nirvana+ supports 8x2 pixel attribute squares, a configuration that is slightly less system taxing. To obtain enhanced palette options some rather fast colour routines needs to go on behind the scenes. The Nirvana+ engine gets the balance between colour and core game code just right. Nirvana has now become the de-facto engine of choice for modern games developers.

It is hard to overstate the enhancements made to the Spectrum's colour usage. 'Gandalf', created by Cristián González and Alvin Albrecht in January 2018 is a brilliant example of the Nirvana+ engine in action. The game follows the favourite Lord of The Rings' character Gandalf seeking revenge on all things Orc. The bright colours are still very much Spectrum features, yet with a gameplay that's more akin to modern platforms.

It's a testament to Richard Altwasser and the Sinclair ZX Spectrums design team that programmers continue to build and develop for this revolutionary home computer of the early 1980s. 

AN INTERVIEW WITH richard altwasser

Richard Altwasser is a British engineer responsible for the hardware design of the ZX Spectrum. After graduating from Trinity College, Cambridge with an engineering degree in 1978, he was hired by Sinclair Research in 1980. First tasked with writing programs for the ZX80, he worked on the circuit board used in the ZX81, and was later promoted to the team working on the ZX Spectrum, where his main contribution was the development of the Spectrum's colour graphics architecture.

After the Spectrum's launch, Richard left Spectrum to start his own computer company, with Sinclair co-worker Steve Vickers. Originally called Rainbow Computing, it was later named Jupiter Cantab, which launched only one major product, a home computer called the Jupiter Ace. However the Ace was not successful, and the company went bankrupt in 1983. Richard subsequently went to work for Amstrad, overseeing its acquisition of Sinclair's computing line, until 1991.

Paleotronic was lucky enough to get to speak with ZX Spectrum engineer Richard Altwasser about his design of the groundbreaking computer system.

Thanks for taking the time to answer some questions for Paleotronic about the ZX Spectrum and in particular the development of the machine's display and video. Does it surprise you that people are still so keenly interested in even the smallest details of the Spectrum after so many years?

The ZX Spectrum was a great success, especially when seen in the context of the competition at the time and the pioneering nature of the market. This success is more notable when it is remembered that the BBC, with its reach into every UK home, funded by the licence holder, decided to back an inferior product that sold less than a third the quantity of the ZX Spectrum. I have admired from a distance, but never really understood the continuing dedicated fascination of enthusiasts. The important legacy of the ZX Spectrum has been a generation of young people who gained a first experience of programming which propelled them into a career in software and computing. Only in recent years have educationalists, at least in the UK, started again to understand the importance of teaching coding.

Could you tell us a little about how you came to be working at Sinclair Research and what led up to your appointment as the lead designer on the Spectrum's display system?

I was delighted, less than two years after graduating from a broad Cambridge Engineering Tripos and having subsequently studied for a Masters in Electronics, to be offered a job back in Cambridge, with an office that overlooked the iconic Kings College Chapel. I already owned a Tandy TRS80, and had taught an evening class in Basic and Computing. I met Clive (not yet knighted) in his offices, he showed me a ZX80, I wrote a few brief programmes during the interview, and could see the potential. I'd not previously heard of the man, his company or products, but saw an opportunity to gain experience. I served an "apprenticeship", assisting Jim Westwood with his ZX81, before he was moved to Clive's favourite Flat Screen TV project, a technology area about which I knew little. I then naturally inherited the task of following the ZX81.



INTERVIEW THE ENGINEER

The day after Richard Altwasser left Sinclair Research, the company had to advertise for "the world's best computer designer" to replace him. He talks to Brendon Gore about the development of Sinclair's exciting new colour computer.

ORIGINAL WRITER, sometime engineering graduate and full-time microcomputer enthusiast, Richard Altwasser was largely responsible for the development of the hardware for the Sinclair ZX Spectrum. Together with Steve Vickers, who went on to be the launch of Sinclair's latest microcomputer from the very beginning.

Richard Altwasser graduated from Trinity College Cambridge with an honours degree in engineering in June 1978. Originally, he had planned to take up a teaching position at a university in the Philippines under the wings of the

UK. But, in the end, he decided to get married and stay in the UK. After writing to 18 different companies, and being offered four jobs, he decided to join Mord Carnage in Worcester. As the head of a small electronics team, he was responsible for installing industrial robots and for designing the company's new programmable control and instrumentation equipment. It was, he says with a touch of understatement, quite a novel field for electronics.

A headhunting firm introduced Richard Altwasser to microcomputers. On his recommendation, Altwasser bought a Tandy TRS-80 and was hooked on the microcomputing bug. He also realised that microcomputers had potential for the work he was doing for Mord Carnage. "I demonstrated a few programs to some of the directors and persuaded the company to buy a TRS-80. I ran a short evening class for the engineers to teach them how to use the thing, and I think it proved quite useful to them."

But Richard Altwasser had become increasingly disenchanted about his career prospects with Mord Carnage. The company was

closely linked to the automotive industry which had suffered serious setbacks during 1979 and 1980. Consequently, the company wanted more business in coming back its production facilities than in developing them.

Altwasser started looking around for another job. An advertisement in the national daily press caught his eye - Sinclair was looking for an electronics engineer. This seemed an ideal opportunity, as Sinclair had made its first real money in the microcomputing market with the launch of the ZX80 a few months previously.

Two interviews followed Altwasser's application to join Sinclair. The first was conducted by a company of recruitment professionals. It consisted of a number of in-depth personal and technical interviews including an intelligence test and a personality profile to determine whether he was an introvert or an extrovert.

The second interview was with Clive Sinclair at Cambridge. "He invited me into his room where he had a ZX80 and sort of asked me to sit down," says Altwasser. "After sitting in silence for a few moments, I thought I had better do something, so I started writing a little program on the ZX80 which started off a lot of conversation. After a few minutes he offered me a job and I accepted it. We shook hands and that was it."

Richard Altwasser joined Sinclair on the first Monday in September 1980. He was immediately informed

of two things. Firstly, Sinclair's ZX80, ZX81 and ZX Spectrum were about to be launched. Secondly, he was told that the chief engineer was going on holiday so it was up to him to write some programs to demonstrate the capabilities of the new ZX81 and ZX Spectrum.

Not surprisingly, Altwasser worked late on his first day at Sinclair. It was a pattern that was to continue for the next two years.

'People who work for Sinclair do not have many hobbies'

"People who work for Sinclair do not have many hobbies", says Altwasser. "They tend to work too much."

Plans for the ZX81 were well advanced by the time Altwasser joined Sinclair. His main contribution to the ZX81 was designing its promotional board. This brought him into contact with one of the policies that differentiated Sinclair from its rivals.

"It is a policy of Sinclair not to employ academics", explains



Did the public's perception of Sir Clive (Sinclair) and Sinclair Research's reputation for delivering creative solutions and innovative products influence the ZX Spectrum's creation?

Clive was fond of telling the press that he, "makes money to be able to invent, rather than invents to make money." Whether the legend of this slightly eccentric self-taught inventor, which he consciously encouraged, helped the commercial success of the products, or the product's success drove the personal myth, is debatable. The two were complementary and inseparable. The public wanted more and naming the ZX Spectrum's two predecessors after the years of their launch, had created an expectation for an introduction at PC World in 1982.

The public expected a colour graphic display, an extended BASIC and an aggressive price. But Clive's involvement in defining functionality went little beyond this. His disinterest in computing has continued to be documented more recently. However, whilst Clive gave Steve Vickers and I great freedom to define the ZX Spectrum features and functionality, he did specify that we should use a Ferranti gate array with Current Mode Logic (a little used transistor gate configuration, related to ECL). He also took a detailed interest in component cost, industrial case design, and he commissioned an artist for the cover for the instruction manual. Steve and I wrote the contents, for which we gained a national award for the "Most incomprehensible" user manual of 1982, a prize for which Clive understandably made no claim.

Home computers such as the Spectrum astounded people with video output being primary driver in that amazement. The exclamation of 'Wow I can put something on the screen seemed a near universal magical moment for people. How conscious were you at the time of the effects your efforts were having on people?

The launch at the PC World show was a revelation for me. Sinclair Research offered prompt delivery for the first one thousand cash orders, and people surrounded the stand four deep on all sides for the first morning. When Steve and I managed a short break, climbing the wide stairway out from the exhibition hall, we fol-

lowed a couple of schoolboys, unaware of our presence, who enthusiastically recounted every detail of the ZX Spectrum specification. The age at which children start programming continues to become younger, but we were surprised at the detailed understanding of these youths and rewarded by their approval.

I've since appreciated that learning anything new is at first a struggle, which reaches a tipping point when gratification repays the effort invested. One key to the traction gained by the ZX Spectrum in the market and on the subsequent careers and hobbies of those first users, was the speed with which someone could reach that tipping point, enter a first programme and produce results on a screen. "Hello World!" quickly became "Welcome to a career in computing."

In the earlier Sinclair computers the ZX80 and ZX81, the Z80 CPU was almost entirely responsible for video generation and the video signal. Were these methods discounted early on in favour of farming out this functionality to TTL logic and eventually into the ULA?

Increasing the RAM memory from 1k Bytes, in the monochrome ZX81, to 16k Bytes was the minimum step needed to enable colour and graphics. To contain cost, required moving from static to dynamic RAM and reading much more video memory. Dynamic RAM also needed refreshing. It quickly became apparent that video access and memory refresh could not be handled by the CPU, but would require dedicated logic, which we implemented in a ULA. Combining memory refresh and video access allowed an important simplification to this circuitry.

When working on the Spectrum's video system, did you consider the computers gaming potential? And was the usage of custom video and sprite generation ICs considered, as was being employed by American manufactures such as Commodore and Atari in their microcomputers?

We certainly understood that people would use the ZX Spectrum not just for learning to code, and the fact that gaming turned out to be a major application suggests that our specification allowed adequately for this. The need to meet a cost target and consequent consumer price point meant that we never gave serious thought to hardware dedicated to sprites or other complex video features.

Amazingly the Spectrum's display file / graphics mode uses less than 7 kilobytes in RAM. Were you working towards very specific memory constraints, or was the target to use as little RAM as possible?

From memory, I believe that 16kB was the smallest DRAM configuration commercially available. The use of one byte per character pixel block for colour and attributes, and eight bytes for pixel data was suggested by three observations. Firstly, the colour resolution of the human eye is less than for luminance. Secondly, the PAL colour TV standard, recognising this difference, has a much lower chrominance than luminance bandwidth. Thirdly, the established and popular Ceefax and Oracle implementations of Teletext allowed for character level colour, with foreground, background

and flashing. A desire to use the smallest possible memory, and the precedent of Teletext character level colour led directly to the adopted scheme.

The slightly latter Timex TS2068 variant of the Spectrum had several additional graphics modes, including a hires mode of 512 × 192 pixels. Were additional modes ever considered for the original ZX Spectrum?

We agreed the specification quickly, the main debates centred around prioritising new software features. I don't recall seriously considering any additional complexity to the video scheme.

To achieve a mere 7 kilobyte memory usage your end solution stores 256 × 192 pixel data into a single bit pixel array in combination with a separate 32 × 24 colour attribute array.

Most micro computers arranged their palette in RGB order, the Spectrum's palette is somewhat different as the colours are organised by increasing luminance. Can you comment on why this choice was made?

This probably arose from my focus on the luminance and chrominance ULA outputs, Y, U & V for which I designed a simple three channel DAC, implemented in the ULA and covered by patents GB19820011723, EP0107687 and WO8303916.

In the original 16k and 48k Spectrum, there are two crystals effecting video generation, a 14 MHz and 4.43 MHz crystal. Employing two crystal induces a continual timing variance in the relationship between pixel and the colour sub-carriers producing a noticeable interference in the video output signal known as dot crawl. What brought about the need for using two crystals, and was the dot crawl known about before the Spectrum's release?

The dot crawl was known about before initial release and considered an artefact that would not limit sales, a judgement that I suggest proved correct. I have little confidence that the original ULA, a design choice passed to me by Clive, and aimed at a price point, had sufficient capacity or speed for the long synchronous counter that would have been needed to fully meet PAL specs. And as no ULA dynamic simulation tools were available, this could not have been tested during design. Dot crawl was later eliminated with the 128k version ULA in which the colour subcarrier was tied to the dot, line, frame and CPU frequencies by dividing from a single faster clock. Although this was after my time with Sinclair Research, it has been documented that this later 128k ULA took a short cut and generated a slightly out of spec. line frequency, a decision that we would not have had time to test in the rush to launch in 1982.

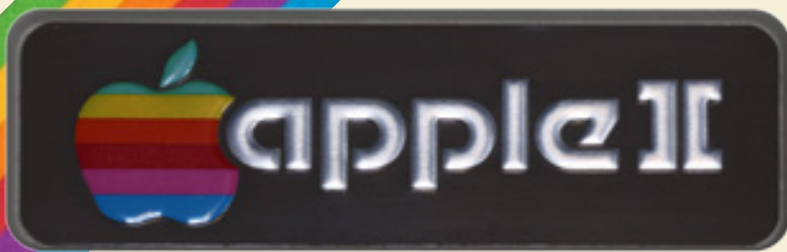
Another more noticeable artefact-ing issue in the Spectrum's video output has become known as the 'snow' effect, where the display substitutes white pixels for real values. This effect appears when the ULA is attempting to read a contended memory address where a Z80 CPU access is already in progress. What was known about this possible bug at the time of design and what could have been done to avoid it?

I don't recall this being a point of discussion at all during testing and launch, perhaps because by synchronising contended video memory transfers to the frame refresh period, available to software via a CPU interrupt, this effect could easily be avoided. As a purely hardware designer at the time, I might well have attributed this artefact to lazy software development rather than a "possible bug".

Lastly, the final design of the Spectrum's video resulted in the now famous attribute / colour clash, inadvertently leading to a whole graphics style associated with British Computing and Gaming in the 80s, not a bad legacy. How do reflect of that now?

I believe the design reasons for the feature you refer to are fully accounted for in answer to your questions above. Given the same circumstances I would be happy to take the same design decisions again, a position reinforced by the knowledge that the ZX Spectrum was several times more successful than its predecessor or BBC competitor, and widely used for graphical games. 🐉





COLOUR COMPUTER GRAPHICS

To keep costs down, Steve Wozniak's design of the Apple II's graphics modes exploited the NTSC colour video standard in a novel way.

Released in 1977, the Apple II was one of the first personal computers marketed towards households rather than businesses. It was a complete computer – it had a keyboard for data entry and the ability to connect to a CRT monitor or a television set. However, unlike its competitors, the TRS-80 Model I and the Commodore PET 2001, the Apple II was able to display colour – but remarkably, it accomplished this without a dedicated colour video chip. The Apple II's video hardware is actually monochrome!

So how does it display colours? The Apple II's designer, Apple co-founder and chief engineer Steve Wozniak, discovered that if he repeated portions of the outgoing digital luminance signal (black or white) and injected it into the “colorburst” or NTSC colour signal (see Radio Waves) instead, various patterns of pixels produced lines of different colours.

The “native” monochrome resolution of the Apple II is 280 pixels wide by 192 pixels deep. Each pixel is either on (1) or off (0). Steve found that using blocks of two pixels, he would get black (00), purple (01), green (10) and white (11). By shifting the timing of the colour signal, Steve was able to get an additional two colours, blue (01) and orange (10). This left him with a “high resolution” graphics mode (HGR) of 140x192.

However, the colour palette (purple and green or blue and orange) could only be changed every seven pixels (with the eighth bit in each video byte used to determine the palette). This made using all four non-monochrome colours on-screen at once a bit

tricky, since one could inadvertently change the colour of adjacent pixels. Also, where two different “coloured” 2-bit (01, 10, etc.) pixels sat side-by-side, you could get “fringing” or artefacting caused by the last bit of the first pixel and the first bit of the second pixel being interpreted by the monitor (or TV – or emulator) as its own different-coloured pixel!

This effect causes white fringes on colour pixels, or colour fringes on white pixels – creating an image that is easily recognisable as originating from an Apple II, as demonstrated below.

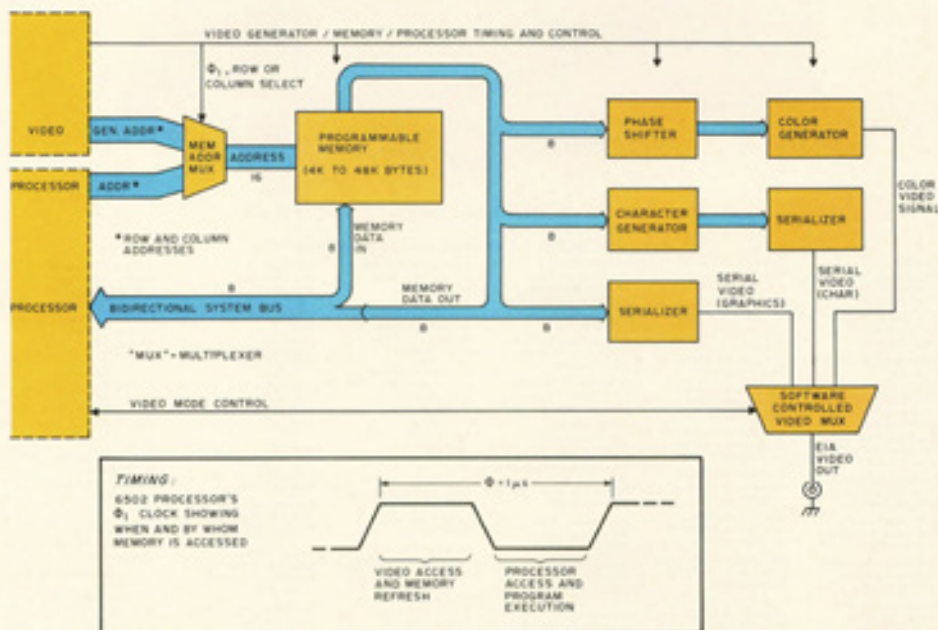


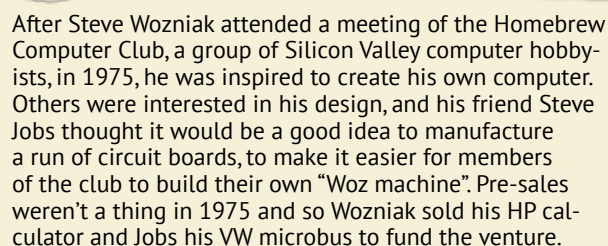
The colours generated in the Apple II's “low resolution” (GR) mode are generated in a similar way, however instead of two-bit patterns it uses four-bit patterns corresponding to 16 colours. These patterns are stored in the memory used for the text screen, with each of 256 8-bit “characters” representing two same or different colour 4-bit pixels, stacked on top of each other, and resulting in a 40x48 pixel display.

If you switch from GR mode to text, you can see the various characters that represent each pixel.

As a result of this technique, on monochrome monitors both low and high-resolution colours are displayed as patterns, usually creating a representation of the colour screen practical enough to be interpreted by the user. Indeed, some applications, such as Apple II Desktop, are actually meant to be used in monochrome, and look terrible in colour! 🐛

The diagram to the left shows the components of the Apple II as they relate to its video sub-system. “Soft switches” toggle on and off various video components, which when active read appropriate memory areas to generate their respective video signals, which are muxed.





Jobs managed to sell around 50 pre-built Apple computers (“Byte into an Apple”) to a local computer store (coincidentally, the Byte Shop). They went on sale in mid-1976, and sold until mid-1977. Meanwhile, Wozniak continued to build on the Apple, refining it as a consumer product and adding high-resolution graphics while working to reduce the complexity (and therefore cost) in as many ways possible. Jobs commissioned a former HP designer to create a case for the upgraded computer.

In June of 1977 the computer, christened the Apple II, was made available for sale to the public. The rest is history.



Jordan Mechner's Karateka, above, uses the second bank of four HGR colours (black, blue, orange and white) while Atarisoft's Ms. Pacman (below) uses both banks (black, purple, green, blue, orange and white.) Games could use one bank, the other, or both.



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Age

G READY

LOADING READY RUN!

In the early 1970s, computers were expensive! Like, really expensive, man! So if you were a young Nolan Bushnell entranced by Spacewar and you wanted to bring it to the masses, how could you do it?

Throughout his career Nolan Bushnell has demonstrated the ability to take an idea and turn it into a success. Nolan is a fan of science fiction and as a child he wanted nothing more than to live in the futuristic worlds he could only read about. His endeavours in entertainment show that he enjoys the fun side of science fiction, with gadgets, gizmos and items that make people's lives enjoyable. During the 1970s and early 1980s Bushnell began his work to bring elements of sci-fi culture into the real world. His pursuits included Atari, which popularised coin operated and home video games and Chuck E. Cheese restaurants, which entertained diners in its pizza bar theatres.

Ever the tinkerer, at the tender age of 6 Nolan created a space ship control panel out of a crate and convinced his neighbours that they were under attack from a UFO of his own creation. When he finished school and made his way to college, one of the majors he chose was engineering. He had seemingly done enough of it in his youth, so it was time to see if he could make a career out of it.

While he was studying he claims to have come across the first ever video game, Spacewar. He spent many hours in the computer lab, playing the game as often as he could. Bushnell was able to see the hold that the game had on himself and others, and considered the possibility of releasing it as a coin operated machine. After graduation Nolan found a job as an engineer at Ampex where he met future collaborator, Ted Dabney.



Nolan Bushnell (as if you didn't know!) in 1982 at Chuck E. Cheese's, his chain of pizza restaurants which featured animatronic shows, costumed performers and video games.



Bushnell introduced Dabney to Spacewar, and while the young engineer wasn't as impressed as his friend, he was never one to turn away from a challenge. Bushnell wanted to create a simplified version of Spacewar that could be mass produced. The duo started by looking into parts that could be easily accessible and cheap.

The project took some time to get moving and as the days turned into months Dabney had started to give up on the idea. On the other hand, Bushnell was as enthusiastic as ever and started to toy with image manipulation on his television. He went to Dabney and posed the question of why the vertical sync on a TV set can make the image move and up down. A follow up question of whether this can be controlled led to Dabney looking into whether it was possible. The men continued their work in the bedroom of Ted's daughter, though some sources claim it was Nolan's daughter who was kicked out of her room. Either way, not even the men's children could get in the way of their masterplan, and the girl was made to sleep on the couch.

Unknown to him, Nolan's discovery had also been made by another engineer known as Ralph Baer. Baer and Bushnell would cross paths numerous times in the following years, each taking inspiration from the other. For now, while Baer was focused on home entertainment Bushnell was looking to develop the first ever coin operated video game.

pixel playas

While Bushnell appeared to drive the project and had the original idea, it was Dabney who worked on the primary electronics and engineering. His big hurdle was that the analog signal he thought could generate the image would not be linear, something that could cause a problem with the timing. This presented new challenges as the engineer had to replicate the process using digital technology. Eventually Dabney's original circuitry was able to display a pixel that could be moved around the screen by external control switches. The basic building blocks were now in place and Bushnell took over the project. Dabney was left in the dark when Nolan, by chance, discussed the project with his dentist. The dentist suggested that Nolan meet with another patient of his, Dave Ralston. Ralston worked for arcade manufacturer Nutting Associates, and after the meeting felt that it would be the perfect home for Nolan's project.

In 1970 Nutting's claim to fame was a game called Computer Quiz, a game that was released in a variety of flavours, including Sports Computer Quiz. The company pooled all of its resources into the project and while the game was popular at college campuses, it failed to pull in the general public. Founder Bill Nutting also had a problem when his chief engineer left the company, leaving them short handed. When the opportunity to manufacture Computer Space came up the company

was in the throes of financial trouble. The situation meant that Bushnell didn't have to try too hard to charm his way into a job, attempting to take Dabney along for the ride.

Initially Dabney didn't have as much faith in the project as Bushnell, so he decided to stick with his secure, full time job at Ampex. Charlie Steinberg, the Ampex president, was concerned about Nolan and told him that it was a mistake leaving such a secure and highly sought after job to work with video games. Undeterred, Bushnell continued with his plans to leave. During negotiations with Nutting Nolan managed to retain the rights to Computer Space and received a 5% royalty on sales of the cabinet. Nutting would cover the costs of manufacture and Bushnell became their one man engineering department. He would work on Nutting's existing projects during the day and continue to develop Computer Space after hours. In spite of his initial reluctance, Nolan managed to convince Ted Dabney to leave Ampex though he was still working on the game with Nolan after hours.

The end result, completed in 1971, was a fibreglass cabinet that contained a raised TV screen and a control panel with buttons. The game is reminiscent of Atari's future classic Asteroids, but the ship has to destroy two UFOs instead of space rubble. Dotted outlines represent the ships on the screen, an expansion on the



no software by Paul Monopoli required



single dot technology that Dabney had developed. He was now able to use the controls to move multiple dots around the screen. The dots were placed and the circuitry on the board told the controls which dots to move. It was Bushnell who had an idea to make the motion of the ship as smooth as possible. He played the dots in an array that would show the ship at four different angles. These dots would be flipped vertically or horizontally if the ship was pointing in another direction.

The AI of the rival ships was extremely simple. The ships would not shoot at the player, but rather in the quadrant of the screen that the player was on at the time. It had to be basic as the game does not contain a CPU and uses no software. In 1970 this would have been prohibitively expensive. Instead the game uses TTL or Transistor to Transistor logic chips. These were connected to a 16 inch monitor that contains five vacuum tubes. The simplicity behind their design meant that this new 'computer' was only capable of playing Computer Space.

When the design was complete Bushnell could see a Computer Space machine standing along side a pinball table at every club, arcade or his own line of amusement restaurants. Chuck E. Cheese was already a germ in Bushnell's mind in 1971 but the decision was made to focus on the new game for now.

After testing at a few locations the game was showcased at the Music Operators of America expo in October 1971. The cabinets that Bushnell and Dabney prepared for the show were found to have been damaged in transit. The monitors had fallen out of the cabinets. The duo managed to repair three of the cabinets but the fourth was unable to be fixed. Bushnell had an idea. If he was going to show the game off to the buying public then maybe they should see how it worked. The fourth damaged unit was opened up so that potential buyers could see how simple the inner workings of the game actually were. Bushnell was reported to be extremely enthusiastic at the expo, talking the ears off anyone who would pass by their booth, whether or not they were actually interested.

While Bushnell claims that no sales were made during the expo, Nutting's accounts tell a different story. Bushnell was suddenly the company golden boy and he even earned a ride in Bill Nutting's personal vintage biplane. Reports of Computer Space's success vary, with critics raving about the game but Nutting management being less than impressed over sales. Bill Nutting's increasing disinterest in the company is one of the suggested reasons for the lack of sales. While exact numbers vary depending on the source you read, the game was considered a failure by Nutting Associates.



Computer Space looked good, but to a public used to the straightforward nature of pinball machines, it was rather complicated, especially all that rotating and thrusting! Could you imagine playing Asteroids with a setup like this? There weren't very many repeat customers, and an arcade game that's not making money is just taking up space (so at least that part of the name was apt.) But it was still the first, and it laid important groundwork for Pong.



Reports vary, but most outlets report that 1500 cabinets were sold after the game's release. A paltry number, but in 1972 newspapers claimed that Nutting was increasing production due to demand. Though records state that production did increase, it might not have been on as large a scale as was reported at the time. Regardless, the game had a hard core fan base and Bushnell was given a lucrative job offer which Dabney managed to talk him out of.

The main feedback from the public was that the game was too complicated. In a world of easy to play pinball machines the average gamer didn't want to spend a couple of minutes reading instructions. They just wanted to insert a coin and start their game. Bushnell took all of the feedback on board and approached Bill Nutting for another shot at it. If he could simplify the game then he knew he would have a hit on his hands. It sounded great, but Bushnell wanted something extra for his trouble. He would create a simplified Computer Space for a one third ownership in the company and a larger role in managing it.

Nolan Bushnell is a personable and charming man, but his status with Bill Nutting was dropping fast. His counter offer was 5% of the company and his continued services as an engineer. While he was no longer the golden boy with the boss he still had his partner, Ted Dabney. The duo met and discussed the glass ceiling they had hit at Nutting Associates and decided it was time to leave and go it alone. They would take their business and make it a greater success than Nutting Associates ever was.

The duo had already started their business in 1969, but there was a problem with the name they chose. Bushnell and Dabney weren't aware that the name Syzygy, the nearly straight line of 3 celestial bodies in a gravitational system, was already taken by another company. Nolan and Ted were keen chess players and this interest led them to play other competitive games, one of which was the Japanese board game Go. Like Chess, one of the positions in Go is 'check' where the opponent is forced to make a move that will save themselves. In Japanese the word is 'Atari', and this is the name that was chosen.

Bushnell understood that the long winded instructions and controls of Computer Space were its downfall, so the next game needed to be immediately accessible. Nolan imagined people playing the game with one hand and holding a glass of beer in the other. Meanwhile, future Atari employee, Steve Bristow, was working with Nutting on a two player version of Computer Space. There are conflicting reports over Bushnell's involvement with the project, but as he claimed no ownership over it (something that would have been unusual for him at the time) it's more than likely he was too busy focusing on his new company and his next project.

In a 2012 interview with Retrogamer Magazine, Ralph Baer claimed that Nolan Bushnell had seen his Odyssey console at the Magnavox dealership in California in March of 1972. He had taken an interest in the Table Tennis game that was built

into the system. Several witnesses have also gone on record claiming to have seen Bushnell at the show. Taking inspiration from this experience Bushnell considered his next move as he hired a young engineer he had worked with at Ampex to help him. The man's name was Allan Alcorn.

At the time Bushnell left Ampex, Alcorn, like many others, was concerned for him. No one ever left Ampex, it was a job for life. Later, when Alcorn received the call to join Nolan he accepted, though in the back of his mind he always assumed he could return to Ampex if he had to. In the meantime this might be a fun little project to work on. Nolan was an interesting guy and the two men had gotten along very well.

Alcorn was initially brought in to work on a driving game, though he thinks this project was only used to entice him to work at Atari and didn't actually exist. When he started work Bushnell had something else for Alcorn to do. He told Allan that Atari had signed a deal with General Electric to create the bat and ball game, though this was also a ruse. The exercise was actually intended to help Alcorn become familiar with the process of creating video games while Bushnell himself worked on a more complex idea. Presumably once Alcorn had completed his side project then Nolan would be ready with the next big game, by which time the young engineer would have some experience in game design. It was a perfect plan, but often the best plans can take on a life of their own.

Alcorn had access to Bushnell's original designs for Computer Space and he was familiar with the workings of the TTL circuitry that was used. Bushnell's documentation of Computer Space probably made complete sense to him, but for everyone else it was practically illegible. Alcorn tried to decipher the mess he was presented with but in the end decided to use his own knowledge of the circuitry and his understanding of Computer Space to work on the project.

Pong did not use a CPU or software to run the game. Instead Alcorn improved on the existing technology used for Computer Space. Like the former game Alcorn started with working on the horizontal and vertical sync pulses. Digital timing circuits were developed that turn objects off and on, depending where they are on the screen. Some elements had to be combined, such as the counters only being allowed to tick over when the ball is displayed.

While Alcorn worked on the project for three months, the basic building blocks of the game were developed within a week and a half. He tested the game and found that it was boring. It was certainly simpler than Computer Space, but probably a little too much. He thought about ways to punch up the gameplay and started to work on improving the basic bat and ball concept.

Alcorn split the paddle into 8 sections. When hit, the three sections on either side would send the ball back at a different angle with the centre two knocking the ball straight ahead. The ball itself has three basic horizontal speeds, with the ball getting faster the longer each round lasts. Restarting a round resets

the speed. The paddles are unable to make their way to the top of the screen as Alcorn discovered limitations in the circuitry. In the end he decided to make it a feature, as a talented player could angle the ball to go over their opponent's paddle. This also ensured that rounds would not last forever.

Alcorn admits that he kept making improvements as he was not getting positive feedback from Bushnell, who loved the game but wasn't forthcoming with his praise. When Bushnell and Dabney did give Alcorn feedback they asked him to put in some sound effects. Nolan wanted the sound of a crowd cheering when a point was scored while Dabney asked for booing when a point was lost. Alcorn was running out of space on the circuit board, so he had to use the existing on board sync generator to create these effects. He claims that this took him half a day to complete.

Unlike Computer Space the only instructions contained on the original cabinet read, 'avoid missing ball for high score'. The control mechanism was a simple circle, which when spun to allow the on screen paddle to move up and down. According to Alcorn, initially the Pong prototype was installed with cheap potentiometers to control the paddles. After they broke he calculated the average amount of turns a person would make per game and how many turns the cheap device could withstand in the real world. Eventually the decision was made to upgrade to a more expensive potentiometer, supplied by a military contractor.

Prior to its release in 1972 Bushnell approached his former employer at Nutting Associates. He proposed a deal whereby Nutting would develop Pong, Atari would retain the rights and receive a 10% royalty on each machine produced. Bill Nutting turned his former golden boy down, a decision he would soon regret. Five years later Nutting was sold, but not before they developed their own line of unlicensed Pong clones.

Famously, the test unit for Pong was installed in Andy Capp's Tavern. Apparently not only named after the famous British comic, the tavern was allegedly known for its ever flowing beer taps and smoke filled interior. Alcorn was unsure about this move as he felt that the cabinet wasn't robust enough to withstand much punishment. A simple knock on the side could damage the machine or the silicon chips could burn out.

Urban legend tells that the Pong machine was so popular that it broke on the second day. The bar owner was reportedly quite angry at this, but Alcorn claims that the whole story was just a myth. From the money that Nolan had made from Computer Space he was able to buy some existing machines and install them at local arcades and bars. Atari already had machines at Andy Capp's Tavern and the owner was well known to them, hence their decision to test the machine there. The famous phone call came about a week or ten days later. Surrounded by upset patrons who wanted to play a game Alcorn opened up the machine and discovered the overflowing coin box. There was roughly \$100 in quarters, meaning that around 400 games had been played during the week. When told about this Nolan simply responded by saying, 'that's interesting...'

Andy Capp's Tavern had regular customers who would pile in at 9AM after breakfast and start drinking. However, one morning some new faces entered the bar along with the regulars. They didn't order any drinks, but instead headed straight for the Pong machine. They inspected the machine as much as they possibly could without opening it up, then they left. From their observations they developed a clone of the game, an achievement Alcorn says was admirable considering they hadn't even seen the circuit board.

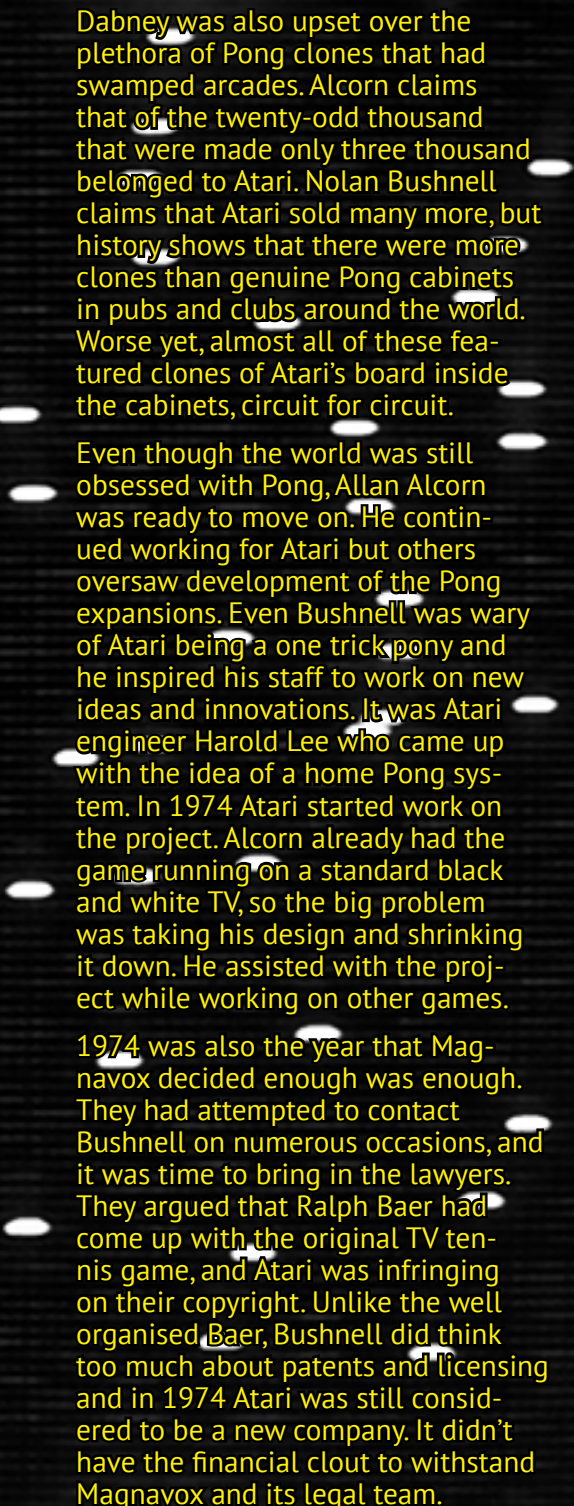
Nolan was enthusiastic about the game, and in typical Nolan style he spoke to everybody who would listen. Bally and Midway both expressed interest in the game, but Bushnell was considering his options. He manipulated both companies into thinking that the other was no longer interested and they both backed away.

With Nutting, Bally and Midway all out of the picture there was no one else who could develop the cabinets. He decided that he would develop them himself and a line of credit was granted by Wells Fargo. Nolan expanded Atari to include a new warehouse and assembly line for the machines. In late 1972 the game was released across pubs and clubs around the USA, and eventually other parts of the world. It was a resounding success as Bushnell knew it would be.

Nolan's original plan was for Alcorn to develop games after creating his ping pong game, and this hadn't changed. Alcorn worked with Dabney on Atari's second game, Space Race. Originally called Asteroid, Space Race was conceived by Nolan Bushnell and Ted Dabney, though Alcorn engineered the final release. Both he and Dabney claim to have designed the game. The graphical techniques used are similar to those found in Computer Space. The whole game was designed to be a simpler version of Nolan's original vision, but with a race between spaceships rather than a shooting match. Both Dabney and Alcorn claim that Bushnell had some input into the project, though how much is up for debate.

The game bombed as players demanded more Pong. Shortly after release the market was flooded with clones, though in all of the excitement Atari themselves seemed to forget that they had made a clone of the Magnavox tennis game, a fact that Magnavox themselves hadn't forgotten. Certain parties claim that at this point Magnavox was already attempting to approach Atari over this fact, but it would be a bit longer before the lawyers were called in.

In late 1973 Atari suffered a few failures with Space Race and its successor, Gotcha. Atari recalled many of the Space Race cabinets and outfitted them with their new game, Pong Doubles. Like the real game, now four players could partake in video table tennis. 1973 also saw Ted Dabney leave the company he co-founded. According to Alcorn, Atari was expanding at such a rate that everybody had to perform different jobs, including manufacturing and shipping. In the end Dabney simply wasn't interested in the business side of Atari, so he left. Alcorn claims to have been heartbroken over his decision.



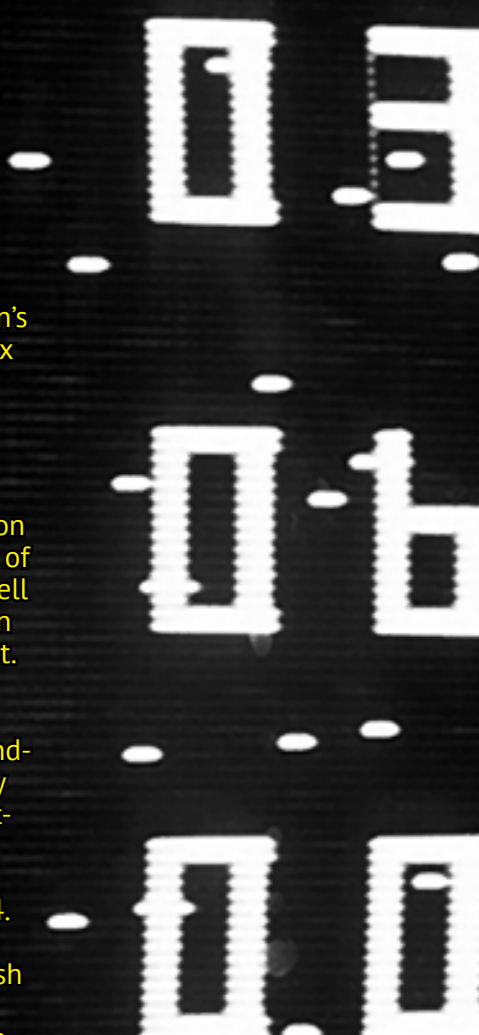
Even though the world was still obsessed with Pong, Allan Alcorn was ready to move on. He continued working for Atari but others oversaw development of the Pong expansions. Even Bushnell was wary of Atari being a one trick pony and he inspired his staff to work on new ideas and innovations. It was Atari engineer Harold Lee who came up with the idea of a home Pong system. In 1974 Atari started work on the project. Alcorn already had the game running on a standard black and white TV, so the big problem was taking his design and shrinking it down. He assisted with the project while working on other games.

april-june 2018

Ever the charmer, Nolan was able to hammer out a deal with Magnavox which was beneficial to both parties. Atari would pay a one off licensing fee of \$700,000 and Magnavox would get the right to any Atari product that was released for the next 365 days, starting in June 1976. During the year Magnavox lawyers made many visits to Atari HQ, though everybody kept quiet about any new developments. Nolan's negotiations saw that the Magnavox deal would end a week before the next CES, meaning that Atari could announce new products without sacrificing the rights to Magnavox.

In 1974 Bushnell decided to focus on running Atari, leaving development of new games to his engineers. Bushnell was the ideas man, and he had been burned by the Magnavox settlement. He decided that he needed to stop being so blasé about the business end of Atari and focus on understanding the industry. He started to apply for patents that would protect existing Atari products. He also pushed his team to work on new games, releasing several new titles in 1974. He didn't want another Pong clone situation, so to keep the market fresh and beat the imitators he wanted a continual string of hits. Unfortunately for Atari it was the Pong clones that were continuing to receive all the attention, and Atari themselves released several upgrades to the existing game to meet demand.

Work was continuing on the home system, something that Bushnell hoped would put a stop to the clones. People would be able to play Pong at home, meaning that when they went out they were more likely to look for a fresh experience. Atari





had recently achieved success with a new game, Gran Trak 10, an over-head racing game. Bushnell had wanted to work on a driving game since Atari's inception, but it was an idea he kept pushing aside in favour of something else. The game was starting to outsell Pong but there was a problem. Poor accounting records meant that the game was sold to vendors for \$995 when it should have been \$1095. Atari suffered a loss on what was supposed to be their next big hit. But there was a light at the end of the tunnel; the Pong home unit was completed.



The Atari 2600

Bushnell took the unit to toy shows, only to find attendees disinterested in the product. Bushnell started to feel a bit lost. Atari could sell the console themselves, but they were already stretching their resources with the arcade games they were developing. Eventually the retailer Sears approached Bushnell and offered to purchase every Pong TV game that Atari could make. Sears put up the money for a major marketing campaign and with the extra cash Bushnell was able to increase production. In 1975 Atari sales increased by \$40 million, a turnaround from the disaster of 1974.

Rather than invest the money Bushnell decided to throw wild parties and buy expensive cars. The profits kept rolling in and Atari was going from strength to strength, but the Pong problem hadn't gone away. Instead of clones appearing in arcades and pubs they were popping up on store shelves. While many of them were from small toy companies, some of them were from bigger names. At this time future gaming juggernaut Nintendo were starting to explore the video game market, a move which saw them releasing five of their own Pong clones between 1977 and 1980.

Bushnell was an innovator and releasing Pong systems on the TV wasn't enough for him. Atari now had a few successful arcade releases that he wanted to get into homes. He needed a system that could play all of these games, and anything else that the company developed. In early 1976 he put Steve Mayer and Ron Milner on the project with Al Alcorn assisting them. They developed a prototype of their interchangeable cartridge system within three months which they codenamed Stella. The problem was the Magnavox agreement had just started. Al Alcorn claims that keeping the Video Computer System (VCS) a secret during the remainder of the allocated year was very difficult. After the agreement had ended Atari debuted the VCS at the 1977 CES to a surprised audience but Atari had already been beaten to the finish line.

Fairchild Semiconductor engineer Jerry Lawson had begun work on a home entertainment system, known as the Channel F. This would be the first home console to use a central processing unit and programmable ROM cartridges. In the latter half of the 1970s prices of semiconductors had significantly dropped in price, justifying their use for entertainment purposes. Atari themselves had already started using them in their arcade games in 1976. Without the Magnavox agreement it's possible that Atari may have beaten Fairchild to market, though Atari did have the superior hardware and an established name. In the end only 27 games were released for the Fairchild Channel F, while the Atari VCS (later named the 2600) remained in production until 1992.



A new era of gaming had begun but while there were still rocky roads ahead, gamers were now able to have a taste of the arcades while sitting on their favourite couch. Home video games were here to stay.



IN THEIR WORDS...



THE AMPLEX CONNECTION: Bushnell hired Al Alcorn as Atari's first full-time engineer. His first project was Pong. Says Alcorn: "He (Bushnell) defined it and I built it."

Hi Allan, thanks for taking some time out to talk with us about Pong. Did you have any idea when you were developing it that Pong could ever be as big as it was?

I was only 24 years old and had no expectations for Atari and Pong other than a paycheck. But the work was both interesting and challenging as raster scan displays, like a TV, were analog devices and the Pong logic board was a digital state machine.

A "state machine"? Could you elaborate on that?

To understand how Pong was designed you need to understand how an NTSC display works. The beam on the display scans horizontally at 15,750 Hz and the vertical scans at 60 Hz. First I had to build a sync generator that used high speed counters that counted the 14.31 MHz clock down to the 15,750 Hz signal for horizontal. It was a simple binary counter that allowed me to access all the intermediate counts so I could define any vertical slice by simply using logic gates to map them out. Similar thing was done to the vertical that counted the horizontal scan lines. By gating the correct horizontal and vertical counts I could map any region on the screen like where the paddles appeared or the net.

Allan "Al" Alcorn was born in 1948 in San Francisco, where he grew up and attended the University of California. After graduating with a BSc in computer sciences in 1971, he worked for audiovisual electronics company Ampex, where he met a number of key individuals who would participate in the early days of Atari and Apple. This included Atari founders Ted Dabney and Nolan Bushnell, the latter hiring Alcorn away from Ampex to work on (eventually) creating Pong.

Al also worked on the Atari 2600 before leaving the company in 1981 and working as a consultant for a number of Silicon Valley startups, including several involved with Bushnell's Catalyst Technologies, one of the first technology incubators. These startups included Cumma, a re-programmable arcade system similar to the later Neo Geo, and Etak, one of the first in-car navigation systems.

In 1998, Al co-founded a company that built a PC-connected children's playset, which was acquired by Lego, and in 2011 he co-founded Hack the Future, a hackathon for elementary school children.

Pong designer Al Alcorn says a few words about his creation.

So what about the ball? It moved both horizontally and vertically...

To generate the ball and allow it to move anywhere on the screen I built another sync generator similar to the first sync generator but this sync generator was built so that I could change the count by +/- one, two or three. These counters were gated so that it created a small dot or ball. If I set the counters to have the same counts at the first sync generator then the ball would be stationary. If I set the vertical part of the counter to be one count less than the first sync counter then the ball would move up the screen one scan line per frame.

How did the "gap" at the top of the screen come about?

The start of the paddle is set by a 555 timer controlled by the potentiometer. The gap at the top is an error with my control of the 555 and I left it in as it allowed a way for the player to lose so they would not play forever.

How does the "english" on the paddle work?

The vertical speed of the ball is set by where the ball hit the paddle. The paddle is 8 scan lines high and I capture the count of where the ball hit to set the vertical speed. Three speeds up, three speeds down and one with no vertical speed.

Thanks Al! 🐉



GRUMBLING IN THE JUNGLE: Alcorn, Bushnell, Warner's Manny Gerard and an unidentified visitor at Bushnell's retreat in 1977. With more than 400,000 VCS units collecting dust in the warehouse, Warner was growing more nervous by the day.



...and Nolan Bushnell says fewer words, but we can find a bit more verbosity hiding in the filing cabinet...

When did you first come across Spacewar? What was it like? What did you think of it?

Graphics lab at University of Utah in 1965 or 6. I was mesmerized.

Was it then that you had the idea to turn it into an arcade machine? Or later?

Because of my knowledge of the arcade business I immediately thought the game had arcade potential if the cost could be brought inline with the current coin op game cost.

Why wasn't it possible to follow through on your idea?

That computer had a cost of several hundred thousand dollars.

How did you hit on the idea to use hardware circuitry instead of a computer?

Several years later I was working on my project and the computers were too slow so I kept having to build small circuits that would offload certain functions to free up computer time. Once I offloaded enough I realized I could offload everything onto small digital circuits.

How were the graphics drawn / rasterised to the CRT?

We scanned out pixel by pixel and created dot matrices using diodes.

What was your relationship with Nutting Associates? How did Computer Space do and why?

I licensed Computer Space to Nutting and then they needed me to come on as chief engineer. CS sold about \$3M which seemed good at the time but in retrospect was disappointing.

And that led to setting up Atari?

Yes, I left Nutting and focused on Atari. 

VG: Let's go back in time a little. When and where did you first become interested in video games?

BUSHNELL: There were a couple of factors involved. My interest really began in the early 1960s when I was studying electrical engineering at the University of Utah. They have a good computer science department there headed by Dr. David Evans, one of the pioneers in the field of computer graphics. Anyway, I used to go over to the department at night and play an old game called Space Wars, which had been written on the first computers at M.I.T. It was a good game, although a little advanced for its time.

Every summer while I was in college I worked as manager of the games department of an amusement park in Salt Lake. I was struck by how old-fashioned most of those attractions were. I mean, knocking milk bottles over with a baseball is not the most contemporary game in the world. I got to thinking one day that there would be a tremendous market for a computer game like Space Wars. But it just didn't make economic sense at the time. It would have taken a heck of a lot of quarters to pay for an \$8 million computer. So I just filed the idea in the back of my mind.

VG: When did you—as they say in computer parlance—retrieve it?

BUSHNELL: Around 1969 or 1970. I was working for Ampex in Redwood City as a research engineer by then. Microcomputers had just begun to hit the market and I could see my idea becoming more viable. Originally, I envisioned linking a number of video screens to one central computer. But as I kept adding more and more elements, one day it just hit me: I can do this whole thing in hardware. Once I figured that out, though, the economics seemed overwhelming.

...and in case you think we've forgotten about Ralph Baer, we haven't, we're just saving the Odyssey 'odyssey' for our video-game issue (coming soon!)

VIDEO GAMES: I'm going to start by shooting from the hip. Doesn't it bother you that Nolan Bushnell generally receives credit for inventing—or fathering, if you will—video games?

Ralph Baer: Well, I've had to make peace with that years ago. Sure it bothers me. I look out there—there will be something like \$10 billion spent on video games this year, the one outstanding product that is named in every report is video games, so why doesn't my name pop up? But, to be perfectly honest, I have to take a back-seat to commercial considerations.

VG: Why is that?

Baer: Sanders has made a considerable amount of money from all the licenses that have evolved from the whole situation. That patent alone (#3,659,285) is worth many, many millions of dollars. We've spent a great deal of time and money defending those licenses in state and federal court—all in an effort to retain the claim of what we have and derive the benefits from it.

Under those conditions, you have to be a little restrained. You have to suppress your ego. Bushnell did one helluva lot for the industry—there's no question in my mind he was the major catalyst in developing the industry. He deserves credit for that. I'd just like to see myself more often identified as *the* inventor.



We don't want anyone to think we're giving short-shrift to poor Ralph Baer – we just followed the thread from Spacewar and thought talking about the Odyssey would just be too much for this already jam-packed issue... but to be clear, the Odyssey was the first video game, and the first electronic anything to really do much with a television besides... well, television. And we will be discussing it at great length in a future issue, promise!

PROGRAMMABLE GAMES

could grasp instantly. Completely reversing his field, Bushnell plunged into the development of a much simpler program, a video version of ping pong. Half a continent away, Ralph Baer had already started work on what he considered to be a rather obvious idea.

By 1971 the Magnavox Odyssey—the world's first videogame system for the home—was virtually completed. The Knoxville, Tenn., manufacturer

television sets. Promotion of the device was inadequate. The unit suffered from Magnavox's failure to switch over to solid-state technology when the rest of the industry made the change.

Even so, Magnavox kept the faith. As the equipment continued to improve, the company round a series of steadily more advanced videogames under the Odyssey imprint. Nolan Bushnell, after much labor developed a video ping pong that he felt sure would instantly appeal to players. He tested the game, *Pong*, in a Sunnysville, Cal., tavern with great success. He built more 'Pong' machines, and it immediately became the hottest coin-operated amusement item. It was easy to understand, a kick to play and a marvelous novelty. 'Pong' uprights began turning up in bars, bowling alleys and candy stores as well as the more traditional arcades.



"The question of how to make use of home TV sets had been bothering me since the early sixties," Baer recalls. "The fact is that even back then there were 62 million T.V. homes—that's TV homes not TV sets. The idea of attaching some device to even a small fraction of that started gaining up the factory for a sales explosion that never ignited. The Odyssey failed to catch on for a variety of reasons."

Some people incorrectly believed that the system was only compatible with Magnavox

It was at this point that the videogame concept branched into two distinct directions. While the

Merry Meet and Welcome!



RPGs, no, it's probably not what your thinking of - rocket propelled grenades. Although those kind of RPG's sure are cool and a very useful weapon in today's current gaming environment. What RPG stands for in this article is, Role Playing Games. Not just any role playing games, it's a trip down memory lane, this article looks at where RPG computer gaming began. In short, it's a little computer gaming history lesson of some of the earliest and most notable RPG computer games created.

If you grew up in the 1970's or 1980's like I did, then chances are you probably played board games on a table with your friends such as Dungeons and Dragons (D&D). It most likely would have been your very first role playing gaming experience, one that did not involve the use of computers, instead pen and paper, a board and dice.

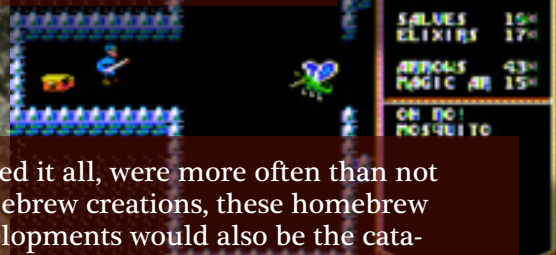
The history of the very first Dungeons & Dragons board game comes down to two men - Gary Gygax and Dave Arneson. As a teenager in the 1960's, Dave Arneson was fascinated with war gaming (you know with plastic figurines, plastic military vehicles, buildings, weapons, that sort of thing), which led Dave to adding role playing into his war gaming experiences.

As a University of Minnesota student, Dave Arneson met up with Gary Gygax at the Gen Con gaming convention in the late 1960's. Soon after meeting Gary, in 1970, Dave Arneson had created his own RPG game, it was based on medieval and fantasy, he ended up calling it Blackmoor. When he showed Blackmoor to Gary Gygax the following year, the pair co-developed a new set of rules that became known as Dungeons & Dragons (D&D). During this development phase, Dave Arneson personalized the massive battles of their fantasy war games with the exploits of individual heroes. This inspiration led to the first fantasy role playing game in which players are characters in an ongoing fantasy story.

COMPUTER
D&D



Screenshot from the
Apple II version of
Temple of Apshai



Storytelling became the core of D&D. You and your friends tell a story together, guiding your heroes through quests for treasure, battles with deadly foes, daring rescues and much more.

The next step in this RPG evolution was computers. As companies like Apple, Tandy, Atari, Commodore and IBM began sprouting and selling there hardware, computers began to enter the retail and society mainstream, RPG's natural selection went from people playing D&D style board games on tables to playing newly created RPG styled games on desktop micro computers.

Origins of the very first graphical adventures that were ported from pen and paper board games on to home computers started to appear around the late 1970's and early 1980's. What i found interesting about researching early graphical computer games is that many well known titles, regarded as RPG legends of that computing era and recognised as the graphical computer games that

started it all, were more often than not homebrew creations, these homebrew developments would also be the catalyst for forming software companies.

Around Thanksgiving of 1978 Jim Conelley had teamed up with John Freeman to form the company called Automated Simulations (which later they renamed the company to Epyx), however it was earlier in 1977 that Susan Lee-Merrow had invited Jon Freeman to join a Dungeons & Dragons game hosted by Jim Connelley and Jeff Johnson. Here is where the homebrew magic of the first ever RPG computer game had become a reality but they just didn't know it quite then.

It wasn't a glamorous beginning, Jim Connelley bought a Commodore PET computer for bookkeeping to help him with being a D&D dungeon master. The purchase of the Commodore PET led to Jim Connelley and John Freeman developing space war themed games but it wasn't until 1979, when they would release a dungeon crawl RPG video



Is it Dungeons and Dragons or Dungeons and Dragons?

Did you read about the fellow who became an enchanted playing D & D, he disappeared for a month?

Chances are, when you play the "Dungeons and Dragons" version, the greatest of all the role-playing fantasies, you'll be able to hold on to reality just a little better.

You're the hero. Enter into the "Temple of Apshai" and into the adventures you've seen advertised in over 100 magazines and newspapers. More than 100,000 copies of the game are sold in the U.S. in the last 10 years.

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Paleotronic new-comer George Bachaelor takes a look back at early graphical role-playing games...

The Bard's Inn



game on the Tandy TRS 80 and Commodore PET, called The Temple of Apshai. In gaming circles this game is thought to be one of the very first graphical home computer RPG games. The role-playing system, named 'Dunjonquest' was designed by Jon Freeman and the level design of the dungeons was provided by Jeff Johnson.

All the ingredients of the pen and paper RPG board games were there but, Temple of Apshai had two other key ingredients: The first computer role-playing game with room descriptions and the second was that it had on screen graphics. In the normal D&D board games verbal depictions were given by a Dungeon Master to detail settings of the game, Temple of Apshai on computer made the Dungeon Master redundant.

You could now see for yourself in all 8-bit glory detailed descriptions about each of the rooms in the game's manual, you could also match an on-screen room number to its entry in the manual that accompanies the game. Other differences from the board game archetype include the player character when beaten by a monster may be rescued by one of several non-player characters. Depending on the rescuer, a portion of the player's inventory is taken away as payment. The game has no particular goal other than fighting monsters, collecting treasure and gaining experience points.

For its time the reception was massive, it held a very long stint in the top games charts from 1979 - 1984 and was still recognized in 1987 as the third best selling game on the Commodore by Epyx. Temple of Apshai was awarded the Origins Award for "Best Computer Game of 1980", the first computer game to receive this distinction.

Temple of Apshai was the first game in a series which spanned ten individual titles, including expansions, smaller games, prequels and a full sequel called Hellfire Warrior. The games appeared on numerous computer systems. Tandy TRS-80, Commodore PET, Apple II, Atari 8-bit computers, IBM PC compatibles, Commodore VIC-20, Commodore 64, Apple Macintosh, Atari ST, Commodore Amiga and later in 1987 the trilogy was adapted to the Amstrad CPC by d3M Software and published in France with the title La Trilogie Du Temple D'Apshai.

1979 appeared to usher in computer based fantasy type D&D RPG games, it was like a euphoric wave of releases and the United States was where the action was happening. Along comes a teenager from Houston, Texas, Richard Garriott. While studying his junior year he takes up a school project using his school's mainframe and an Apple II computer. He calls his work in progress video game "D&D".

Ultima

He continually shows the game to his friends asking for feedback and gives it to them play testing, he never really thought the game would be seen by the public. After 28 revisions of his game D&D, it has a limited release in 1979 with the name Akalabeth: World of Doom. A new decade begins, in 1980, California Pacific Computer Company received a copy of Akalabeth: World of Doom. They contacted Richard Garriott to publish the game, the game that was designed just as a hobby ends up becoming recognized as one of the earliest known RPG examples and a predecessor to the Ultima series collection of RPG games.

The California Pacific Computer company suggested that for marketing purposes “Lord British” be credited as the author; they engaged with enthusiasts of the RPG computer genre by organizing a contest for Softalk magazine readers to figure out the true identity of Lord British.

Akalabeth: World of Doom, was derived as well as inspired by Richard Garriott's love of playing pen and paper D&D and reading the works of J. R. R. Tolkien, the name Akalabeth, derives from Tolkien's Akallabêth, part of The Silmarillion; though the game is not based on Tolkien's story.

While not explicitly stated, Akalabeth: World of Doom, is seen as the first game of the Ultima series, a very popular and influential series of role-playing video games. It was, therefore, included as part of the 1998 Ultima Collection where it officially picked up the nickname Ultima o. The version in the Collection added CGA colors and MIDI. It ran on DOS, making it the first official port of the game to any system other than the Apple II, though an unofficial, fan-made PC version had circulated on the Internet since late 1995.

How Akalabeth differs from The Temple of Apshai is that the player receives quests from Lord British (Garriott's alter-ego and nickname since high school), to kill a succession of ten increasing-



Akalabeth became known as Ultima I, which had many sequels.

ly difficult monsters. The majority of gameplay takes place in an underground dungeon, but there is also a simple above-ground world map and text descriptions to fill out the rest of the adventure. The player could visit the adventure shop to purchase food, weapons, a shield and a magic amulet; the player's statistics can also be viewed in the shop.

Akalabeth: World of Doom, used concepts and innovations that would later become standard in the Ultima RPG game series including:

- First-person gameplay in dungeons.
- Requiring food to survive.
- A top-down overhead world view.
- Hotkeys used for commands.
- The use of Elizabethan English.



During Garriott's 28 earlier versions of his D&D work in progress he had used an overhead view with ASCII characters to represent items and monsters. However, after playing Escape, an early maze game for the Apple II, he decided to switch to a wire-frame, first-person view for the underground dungeon portions of the game, making it the first computer role-playing game with such graphics. The game asks the player to provide a “lucky number”, which it uses as a ran-

dom seed to generate the rest of the game, including dungeons and player stats; by using the same number the player can always return to a given world. The Ultima Collection version added save game support while still using a similar random seed.

While crude by modern standards, in 1980 Akalabeth: World of Doom graphics and dungeon crawl gameplay mechanics were considered quite advanced, the game attracted a large amount of attention. As Akalabeth had been written in Applesoft BASIC, an interpreted language, it was a simple matter for users to modify the source code to suit their needs or desires. For example, the game's magic amulet which occasionally did unpredictable things, like turn a player into a high-powered Lizard Man, or a weak Toad, could be set for “Lizard Man” with every use, progressively increasing the player's strength to the point of virtual indestructibility. One could also set the player's statistics (normally randomly generated and fairly weak to start) to any level they desired.

Richard Garriott aka Lord British holding an original copy of Ultima: Akalabeth.

MYSTERY HOUSE

Magazine columnist, Steve Jackson reviewed Akalabeth in The Space Gamer No. 36. He commented "On the whole, I recommend Akalabeth highly. The graphics are better than I've seen on any similar game; the program is varied and fairly logical. And it's fun."

1980, enter Roberta Williams. RPG computer games were no longer about fantastical medieval adventures. Roberta Williams designed, wrote and illustrated a role playing graphic horror adventure computer game called Mystery House. Roberta knew very little in the way of computer programming, so to get the game onto the Apple II she managed to convince her husband to code the game and the rest they say is history.

The story is that Ken Williams (Roberta's husband) borrowed his brother's Apple II computer to programme Mystery House. Roberta suggested that adding graphical scenes to the otherwise text-based game would make it more interesting, they bought a VersaWriter machine, which allowed them to trace over a line drawing. Roberta drew 70 scenes for the game. However, Ken found that the resulting

digital drawings were too large to fit into a 5¼-inch floppy disk, instead he stored the images into the game as instructions for the program to re-draw the lines of the scenes rather than be static images, as well as writing a better version of the VersaWriter scanning software.

The resulting game was a text-based adventure with a depiction of the character's location displayed above the text. The homebrew RPG game Mystery House would, in 1980 lead to the creation of the company called On-Line Systems, which would evolve into Sierra On-Line.

Mystery House is known as one of the earliest horror video games. The game starts near an abandoned Victorian mansion. The player is soon locked inside the house with no other option than to explore. The mansion contains many interesting rooms and seven other people: Tom, a plumber; Sam, a mechanic; Sally, a seamstress; Dr. Green, a surgeon; Joe, a gravedigger; Bill, a butcher; and Daisy, a cook.

Initially, the player has to search the house in order to find a hidden cache of jewels. However, terrible events start

Partial screenshot from Ultima: Akalabeth.

ATTACK
ON AXE
OR SWING : ✖

Next 8 Pages!!

DR. KURSON'S KLINIC page 59
GAME STRATEGY page 60
MICROTONES page 62
CONTEST page 64

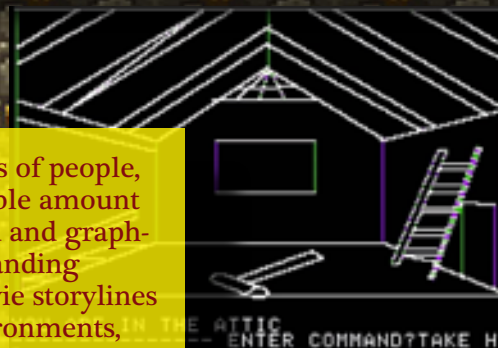


Designer Lord British Stalks The 'Ultimate' Ultima

time, I said "Hello." They looked at me like I was crazy and one of them said "Hello?" Nobody around here

most equal in size to an entire Ultima II game. Ultima IV is also very different in

Screenshots from the Apple II version of Mystery House



happening and dead bodies (of the other people) begin appearing. It becomes obvious that there is a murderer on the loose in the house, and the player must discover who it is or become the next victim. Roberta Williams has been quoted as saying the inspiration for this type of RPG computer game came from the Agatha Christie's novel, 'And Then There Were None'.

Mystery House had great success at the time of its release in the early 1980's, this success received critical recognition. Mystery House was ranked fourth in 1996 by Computer Gaming World on the magazine's list of the most innovative computer games and GamePro acclaimed Mystery House 51st most important computer game of all time in 2007 for introducing a visual component to an RPG for featuring graphics at a time when most computer games did not.

In today's computer and console gaming, RPG's are the norm. They are

developed by massive teams of people, with the hardware's incredible amount of memory as well as sound and graphics cards, it allows for outstanding realism graphics, huge movie storylines and a diverse range of environments, there is an RPG computer / video game for any idea or concept developers can imagine. Yet in the late 1970s and early 1980s where RPGs began, it was when board games such as D&D went from being played on your kitchen table top to a computer desk top machine. It was homebrew developers using BASIC coding languages and hardware with anything between 4kb - 64kb of memory. By today's standards early RPG's may appear completely ancient, but back in the day, graphical text based adventure gaming the likes of The Temple of Apshai, Akalabeth: World of Doom and Mystery House set the standard in computer and video RPG gaming, it was these games that were at the forefront of the home computer gaming evolution.



Viewers without Ceefax-compatible televisions could purchase "adaptors" (really, simple computers) to allow them to access the information.

TELETEXT



ADD-ON ADAPTOR

£199 inc. VAT

THE RADOFIN TELETEXT ADD-ON ADAPTOR

Plug the adaptor into the aerial socket of your colour TV, and receive the CEEFAX and ORACLE television information services.

THIS NEW MODEL INCORPORATES:

- * Double height character facility
- * True PAL Colour
- * Meets latest BBC & IBA broadcast specifications
- * Push button channel change
- * Unnecessary to remove the unit to watch normal TV programmes
- * Gold plated circuit board for reliability
- * New SUPERIMPOSE News Flash facility

The logo of the British Broadcasting Corporation's "Ceefax" service. It was the first digital information broadcasting service, launched in 1974.



THE FIRST TELETEXT INFORMATION SERVICE

How one-way teletext works: a bit stream of digital data encodes alphanumeric and/or graphic images at a transmission rate the particular TV system can handle. The data are inserted or multiplexed on unused lines in the vertical blanking interval when scanning of the TV picture begins. These lines are at the top of the TV screen on part of the tube the cabinet hides and are not seen by viewers of regular programs. A decoder in or attached to the TV set accepts the data, stores one or more pages in buffer memory, and displays pages on the screen as summoned by the viewer on his keypad.

May 1982 © Creative Computing

Ceefax was an extremely simplified form of the World Wide Web. Users could navigate a menu-system eventually consisting of hundreds of numbered "pages". Some pages provided information, and others directories of other pages. Pages could link to other pages by referencing their numbers. Users typed desired page numbers into their remote control, and could navigate the information quite efficiently.

The service provided a variety of information typical to newspapers of the day, including news, weather, sport, finance and community updates, as well as articles on science and technology subjects. But unlike newspapers, Ceefax's information was updated in real-time.

Often, the first place breaking news could be found was on the service. Ceefax journalists would monitor the various newswires, and then when news broke or was updated, they would use a computer terminal to update the appropriate Ceefax page (of which there were originally only 24). They would then create a punched tape,

CEEFAX 1 100 Sun 5 Oct 23:56



East Sport

ALL THE LATEST SPORT FROM YOUR AREA 390

A-Z INDEX	199	NEWS HEADLINES	101
BBC INFO	695	NEWS FOR REGION	160
CHESS	568	NEWSROUND	570
COMMUNITY BBC2	650	RADIO	BBC1 640
ENTERTAINMENT	500	READ HEAR	BBC2 640
FILM REVIEWS	526	SPORT	300
FINANCE BBC2	200	SUBTITLING	888
FLIGHTS	440	TOP 40	528
GAMES REVIEWS	527	TRAVEL	430
HORSERACING	660	TV LINKS	615
LOTTERY	555	TV LISTINGS	600
SCI-TECH	154	WEATHER	400

Ceefax: The world at your fingertips

In the 1960s, the BBC experimented with the idea of broadcasting a newspaper to hard-copy printers in homes during the early hours of the morning. It worked by rasterising (converting into lines) text, sending it as a TV image to a special printer that could receive and print it. However, the printer was noisy! Who was going to want that in their house clattering away at 3am? The project (called Beebfax) was shelved in 1970.

However, technology was advancing quickly, and the project was soon revived in electronic form. Ceefax broadcast digital text information which was decoded and displayed on television screens using a simple computer system. The BBC began test transmissions in 1972 and rolled-out the system in 1974.

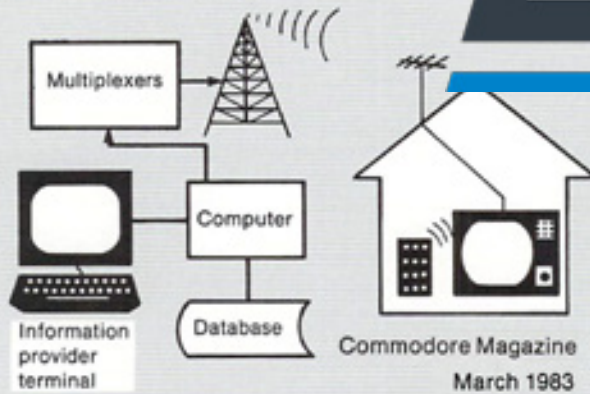
● Both teletext and viewdata must overcome the ingrained attitudes consumers have toward their TV sets. To date, television has been a passive medium, used mostly for entertainment and leisure. Public television has been running up against this problem for years, and there is no reason to believe that videotext will have an easier time of it.

"The real question comes down to consumer need for the service," says Sigel in the concluding chapter. "Obviously there are some individuals addicted to news or financial reports, who absolutely must be plugged into a device that feeds them the latest information. But how many are there, and in what way are they willing to support the service by paying for it?" *Microcomputing, January 1981*

NO CARRIER NETWORKING AND TELECOMMUNICATIONS

Ceefax team members encoded pages using computer terminal, which would then be transferred to the video encoder using paper tape. The encoder inserted an invisible signal containing the data into the BBC's TV channels.

FIGURE 1.1 Broadcast Teletext.



P100 CEEFAX 100 Mon 3 Oct 20:49/50

BBC ONE CEEFAX

NEWS HEADLINES101	THE DEAF ..169
NEWS IN DETAIL 102-119	SUBTITLES 170
NEWS FLASH150	
NEWS INDEX190	TV/RADIO 171-4
NEWSREEL199	TV CHOICE ..177
	TOMORROW ..178
FINANCE HEADLINES ..120	DAY AFTER ..179
CITYNEWS121-139	
SPORT HEADLINES ...140	WEATHER/TRAVEL
SPORT PAGES ...130-159	INDEX180
	GENERAL INDEX
FOOD GUIDE161193-5
BBC RADIO FOR SCHOOLS.....BBC2 276	

which would then need to be carried down two flights of stairs to the "Central Apparatus Room" where the Ceefax signal was actually encoded, and fed into the equipment there. Woe betide the journalist who made an error – they would have to do it all over again, and there wasn't a lift!

Ceefax data was sent during the Vertical Blanking Interval – the period where the electron gun of a cathode-ray tube television returned to the top of the screen.



During this period, the television transmitter broadcast a vertical synchronisation signal and a bunch of blank horizontal lines (which can be seen as a black bar between frames when a CRT television loses vertical sync and "rolls", as pictured.)

Engineers working on the original Ceefax project realised that some of those 25 or so empty lines could be used to transmit digital data, by encoding a binary pattern into the signal. No modification to the existing television standard was required – the Vertical Blanking Interval provided the engineers with a "free lunch".

However, this method obviously couldn't provide data on demand, it could only stream data passively to a receiver. Also, RAM was expensive, and people couldn't be expected to leave their Ceefax decoder (or compatible TV) on all the time! So, given all of that, how on Earth did it work?

Ceefax, a system run by the British Broadcasting Corporation (BBC), uses a television signal as its transmission medium. The signal can carry regular programming at the same time, since the digital information is only transmitted in the interval when the receiver's picture-forming electron beam is returning from the bottom of the screen to the top.

Ceefax transmits information in "pages" of text, each containing 24 lines of 40 characters. It takes 0.25 second to transmit a page. Ceefax customarily transmits 100 pages in an endless loop, repeating every 25 seconds. A television set with a suitable adapter can select a page by number, decode it, and display it on the screen for as long as the viewer wishes.

Ceefax is used to transmit information of general interest, such as weather, news bulletins, sports results, food prices, and recipes. Its capacity is limited by its cycling time: the more pages transmitted, the longer it takes to transmit them all, and the longer it may take the viewer to obtain a certain page after he requests it.

INTERFACE AGE MARCH 1980

Specially equipped TV receivers are now available to provide us with current weather, sports, news headlines, tonight's television shows, local events of interest, and many other interesting bits and pieces of information. The magic word in this scenario is information. Almost anything of general interest can be formatted and sent to your home by the systems to be described in this article.

In England, a set-top adapter currently available for this service is priced at \$250. The cost of the LSI integrated circuits that will form the heart of these adapters is less than \$50. I feel that there is the possibility of adapting this hardware, which will be produced in large volume for consumers, for use on the ham bands.

Teletext is a generic term for television-based sys-

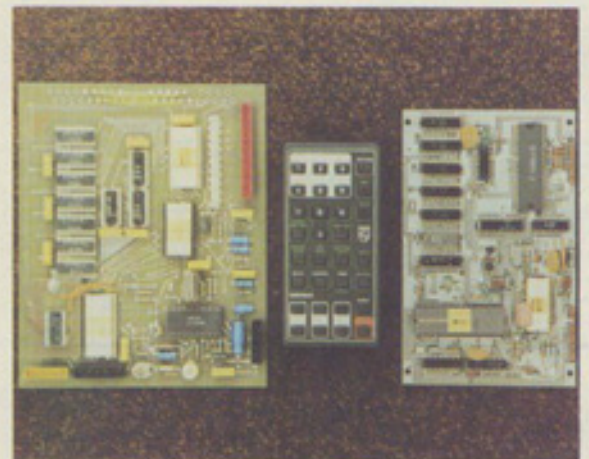


Photo A. Typical teletext hardware. Left to right: Mullard module, remote control, and Texas Instruments module.

120 73 Magazine • December, 1980



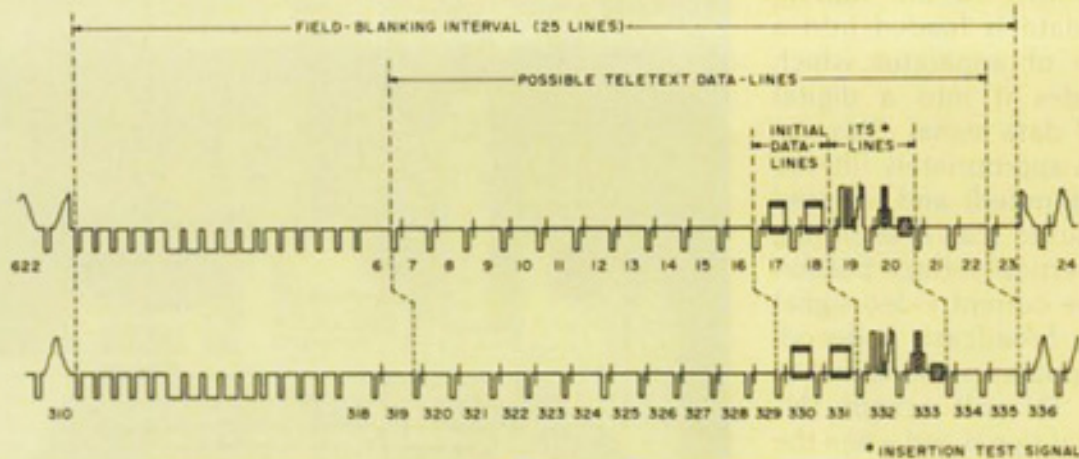


Fig. 2. Insertion of teletext signal in 625-line video signal.

The solution was to repeat the data containing all of the available pages over and over again, broken up into pieces and spread out across hundreds of vertical blanking intervals. Each page contained an identifying header, and when a user requested one, the decoder would simply wait until that header appeared, and then copy the data subsequently decoded into the Ceefax receiver's video memory. It didn't need any additional memory, and this helped to keep the cost of receivers reasonable for the time.

Commonly accessed pages could be repeated more frequently than less-commonly accessed ones, which could mean sizeable delays (of up to 15 seconds) for low-demand pages, but most Ceefax users didn't seem to mind – it was still faster than going to the newsagent.



Interestingly, the original Ceefax project was intended to find ways of providing information those with visual disabilities, and its method of encoding information into the VBI would eventually in accomplishing precisely that, in the guise of closed captioning.

In fact, in North America, it is the only form of "teletext" that ever gained widespread adoption – while Ceefax would lead the way for other teletext services, including fellow UK competitor, ITV's Oracle, the Antiope system in France, and Austext in Australia, commercial US networks couldn't justify the cost of implementation when American consumers weren't interested in it enough to pay for the additional cost of teletext receivers, or additional circuitry in television sets.

With the rise of the Internet and the end of analogue broadcasting, the Ceefax service came to a close in 2012, after 38 years.

"As the decade of the 1980s approaches, new technologies and new economic forces are at work to turn that most familiar of appliances, the television screen, into a true information terminal. These technologies are coming from the electronics revolution in the two worlds of video and computers. The economic forces reflect the willingness of business (and some individuals) to pay high costs for information, provided the information is tailored to their needs and can be delivered nearly instantaneously."—Efreim Sigel
90 Personal Computing SEPTEMBER 1980

The character set used in the Ceefax (and other) teletext systems (examples shown to the right) contained a number of specialised "graphics characters" which could be used to create on-screen borders and dividers, build rudimentary shapes and make up larger letter forms. It could also be used for more sophisticated "teletext art" (see The Art Scene).

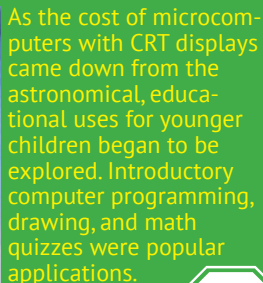
Unfortunately, teletext never took off in North America (left) with expensive information services such as CompuServe and GENie filling the gap instead. Too bad!

The diagram above describes the vertical blanking interval, and where teletext data can be inserted into it. This is ignored by a normal television, but retrievable by teletext receivers.



BBC Research Department started work on CEEFAX in 1970 and one of the first things that had to be built was a decoder to drive a receiver. It was built from standard components and was rather large — in fact it was about as large as a standard television set. Soon, however, the semiconductor industry became interested in decoder design. The usual miracles of miniaturisation were performed and the complete decoder was produced on a board about 6 inches by 4 inches which could easily be integrated into the television set.

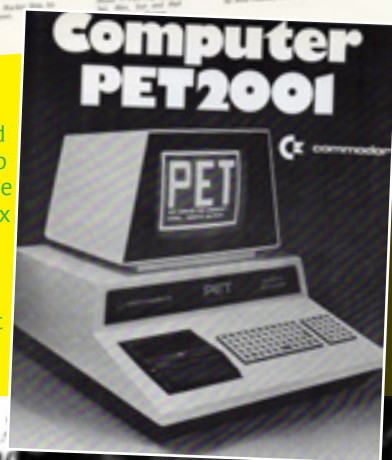
BBC Engineering December 1978



Without the tube, computers were just boring.

After Texas Instruments froze Commodore out of the calculator market by drastically increasing the cost of its chips, the company went searching for a new product. Steve Jobs approached Commodore with the Apple II but CEO Jack Tramiel

felt Jobs wanted too much for it. He directed his company to develop their own computer. The PET was designed in six months, and released in 1977. It became popular in schools in Canada and the US, but was eventually beat out by the Apple II!



The television gave teachers the ability to allow their classes to experience important historical events, such as the Moon landing, in real-time. The advent of the uMatic VCR also encouraged the development of educational programs and permitted the distribution of documentaries much more conveniently than on 16mm film. They were significantly more engaging than film strips!



THE

noise

CHANNEL

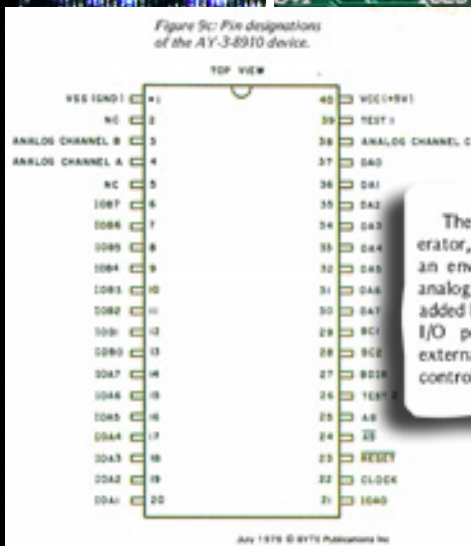
The noise generator in General Instrument's AY-3-8910 chip helped to create the distinctive qualities of early video-game sound effects and music.



Figure 5c: Pin designations of the AY-3-8910 device.

Above: AY-3-8910 sound chip mounted on a circuit board.

Left: Its pin diagram.



The AY-3-8910 incorporates a noise generator, three tone generators, three mixers, an envelope generator and three digital to analog converters for amplitude control. An added benefit is the inclusion of two decoded I/O ports which are available for other external applications. All subsystems are controlled through the control register array.

Below: Examples of register values for two popular 8-bit sound effects, a whistling bomb and a phaser.

Whistling Bomb Sound Effect

Register Number	Hexadecimal Load Value	Explanation
Any not specified	00	
R7	3E	Enable tone only on channel A only.
R10	0F	Select maximum amplitude on channel A.
R0	30 (start)	Sweep effect for channel A tone period via a processor loop with approximately 25 ms wait time between each step from 30 to C0 (0.429 ms/2330 Hz to 1.72 ms/582 Hz).
R0	C0 (end)	
R6	0F	Set noise period to midvalue.
R7	07	Enable noise only on channels A,B,C.
R10	10	Select full amplitude range under direct control of envelope generator.
R11	10	
R12	10	
R14	10	Set envelope period to 0.586 seconds.
R15	00	Select envelope decay, one cycle only.

Phaser Sound Effect

Register Number	Hexadecimal Load Value	Explanation
Any not specified	00	
R7	3E	Enable tone only on channel A only.
R10	0F	Select maximum amplitude on channel A.
R0	30 (start)	Sweep effect for channel A tone period via a processor loop with approximately 3 ms wait time between each step from 30 to 70 (0.429 ms/2330 Hz to 1.0 ms/1000 Hz).
R0	70 (end)	
R10	00	Turn off channel A to end sound effect.

THE ARCADE games of the 1970s used dedicated circuits for sound – even the sound chip in the **Atari 2600** only had a set of pre-defined sound effects and an oddly-tuned tone generator. Realising that the emerging home computer and video-game industry provided a new market for a digital sound-synthesis chip, in 1978 **General Instruments** designed what they designated the **AY-3-8910**.

The 8910 featured three separate sound channels, each of which could produce a single oscillating **square-wave** tone. In addition, there was a **noise channel**, which could be mixed into the three tone channels. This was intended to permit game programmers to create **explosions**, gunshots and other sound effects, but would be also used later to create **drum** sounds, especially by future “**chiptune**” composers.

A set of **hardware envelopes** were also included in the chip. Envelopes **shape** the volume of a generated tone (and/or noise) – for example to **trail off** at the ending of a flute sound, or taper off an explosion – and **repeating** envelopes at high frequencies could be used to crudely reshape the square wave into a **sawtooth** or a **triangle** wave, providing variety in the **timbre** of the tones.

However, there was only one envelope generator shared between all three channels, so on host systems with faster **CPUs**, sound and

By setting various registers with appropriate values, a large variety of sound effects and musical tones can be created.



This Apple II music "demo" by group French Touch features a number of AY-3-8910 "chiptunes", many from the Atari ST.

music programmers often manipulated the volumes of the tones directly, creating **software envelopes** instead.

The 8910 was a **state machine** – that is, the **parameters** of the components (**tone generator**, **volume**, **noise mixing** and **envelopes**) – the **state** – used to generate the **audio output** were programmed into various **registers** inside the chip (often **dynamically** – on the fly) and these states resulted in a finite set of outputs. This was ideal for audio synthesis.

Because while the parameters of individual components were **limited in their flexibility** (aside from the tone generators, which had a wide range and fairly accurate precision), the **possible combinations** of all the components **working in concert** and the ability to constantly modify them without needing to stop and restart audio generation led to a fairly wide, **although distinctive**, variety of **musical tones** and **sound effects**.

These qualities led the 8910 to become quite a popular choice amongst the designers of 1980s **pinball** and **arcade** machines, as well as a number of **home computers** and **video-game consoles** including the **ZX Spectrum 128**, **Amstrad CPC**, **Intellivision**, and **Vectrex**. It was also central to add-on sound cards for the **Apple II** (whose built-in sound was a simple 1-bit speaker), some of which featured **dual 8910s** working in parallel with each other, providing 6 channels of **stereo sound**.

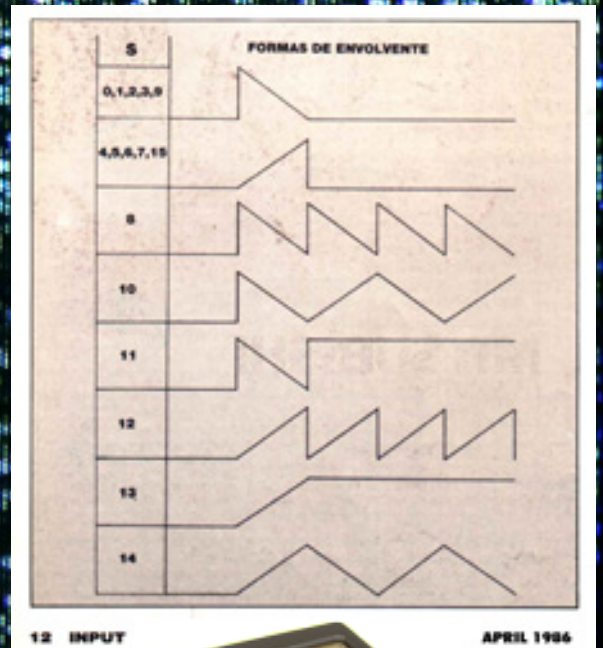
A later variant, the **Yamaha 2149F**, was used in the **Atari ST**, bringing the 8910 into the age of **16-bit gaming**, and firmly cementing its legacy as one of the **champions** of video-game sound.

Here's to the **AY-3-8910!** 🎮

Mattel's Intellivision console, released in 1979, featured an AY-3-8910 sound chip, which gave it a serious edge over the Atari 2600, whose sound was generic and repetitive. While the Intellivision would fail to overtake the 2600 (due in part to its competitor's vast library of games), over three million of them were sold between 1980 and 1983, and games would continue to be released until 1990.



The AY-3-8910's hardware envelopes



CHIP TO BE SQUARE

Developed in Sydney, Australia, the Fairlight CMI (short for Computer Musical Instrument) was one of the first digital sampling synthesisers.



Co-founder of Fairlight Instruments Peter Vogel, pictured with the Fairlight CMI III – the last of the CMI series – in 1985.

After Sydney-native Peter Vogel graduated from high school in 1975, his classmate Kim Ryrie approached him with the idea of creating a computer microprocessor-driven electronic musical synthesiser. Ryrie was frustrated with his attempts at building an analogue synth, feeling that the sounds that it could produce were extremely limited.

Vogel agreed, the pair spent the next six months in the basement of the house they rented to be Fairlight's headquarters working on potential designs. However, it wasn't until they met Motorola consultant Tony Furse that they made a breakthrough.

In 1972 Furse had worked with the Canberra School of Electronic Music to build a digital synthesiser using two 8-bit Motorola 6800 microprocessors, called the Qasar. It had a monitor for displaying simple graphical representations of music, and a light pen for manipulating them.

However, Furse's synthesiser lacked the ability to create harmonic partials (complementary frequencies created in addition to the "root" frequency of a musical note in acoustic instruments, for example when the string of a piano or guitar is struck) and the sounds it emitted lacked fullness and depth. Ryrie and Vogel thought they could solve the problem, and licensed the Qasar from Furse. They worked on the problem for a year without really getting anywhere.

Late one night in 1978, Vogel proposed they took a sample (digital recording) of an acoustic instrument, and extract the harmonics using Fourier analysis. Then they could recreate the harmonics using oscillators. But after sampling a piano, Vogel decided to see what would happen if he simply routed the sample back through the Qasar's oscillators verbatim. It sounded like a piano! And by varying the speed of playback, he could control the pitch. It wasn't perfect, but it was better than anything else they had come up with, and off they went.

There is a booth for the Fairlight CMI, the Australian super-synthesizer, but there is no way to get close enough to it to see what's happening.

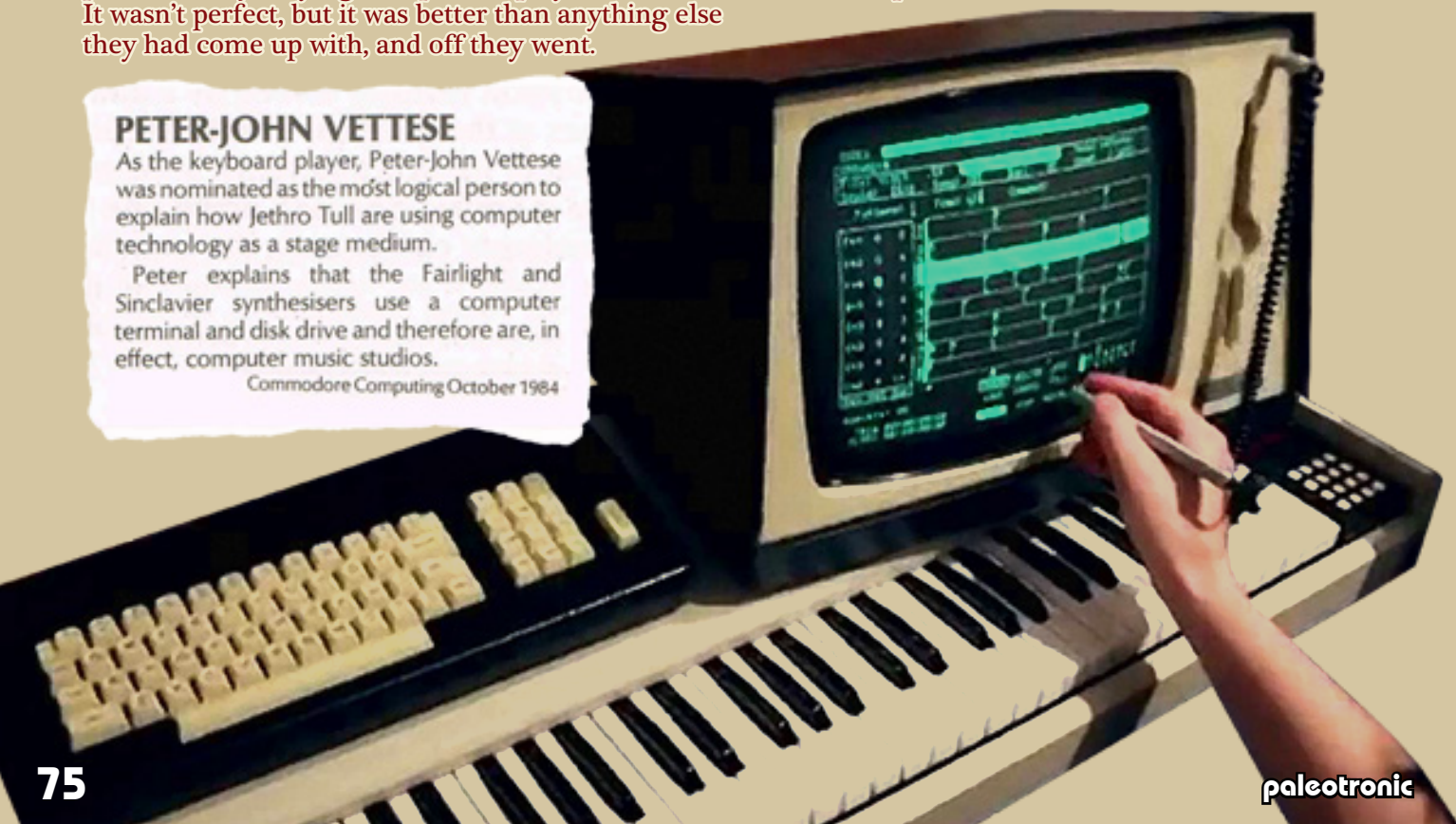
April 1984 © Creative Computing

PETER-JOHN VETTESE

As the keyboard player, Peter-John Vetteese was nominated as the most logical person to explain how Jethro Tull are using computer technology as a stage medium.

Peter explains that the Fairlight and Sinclavier synthesisers use a computer terminal and disk drive and therefore are, in effect, computer music studios.

Commodore Computing October 1984



They continued to work on the idea of digital sampling while selling computers to offices in order to keep the lights on. They added the ability to mask the digitised sounds with an ADSR (Attack Decay Sustain Release) programmable envelope, allowing for some variation.

They also added a QWERTY keyboard to go with the monitor and light pen (a light-sensing “pen” which can tell its location on the surface of a CRT by synchronising with the video signal), and an 8-inch floppy diskette for storing sample data, which was loaded into the CMI’s 208KB of memory). It really wasn’t much room – at 24 kilohertz (a CD-quality recording is typically 44.1kHz)

a sample could only last for one-half to one second – not very long.

Longer sounds needed to be recorded at even lower sample rates, but Vogel credited their low-fidelity (think landline telephone) for giving the CMI a certain sound. However, despite its deficiencies, Australian distributors and consumers were interested, so much so that the Musician’s Union warned that such devices posed a “lethal threat” to its members, afraid that humans in orchestras could be replaced!

In the summer of 1979, Vogel visited the home of English singer-songwriter Peter Gabriel, who was in the process of recording his third solo album.

Vogel demonstrated the CMI and Gabriel was instantly engrossed with it, using it over the following week to “play” sounds such as breaking glass and bricks on songs in the album. He was so happy with it he volunteered to start a UK distributor for the CMI, which went on to sell it to other British music artists such as Kate Bush, Alan Parsons and Thomas Dolby.

The Americans soon caught on as well, with Stevie Wonder, Herbie Hancock and Todd Rundgren all taking a shining to the CMI amongst many others. But they weren’t interested in using it for reproducing real instruments – rather it was the surreal quality of its sounds combined with the built-in sequencer which made it an attractive addition to their musical toolbox.

Over the following decade, three generations of CMI, with upgrades such as MIDI support, higher sampling rates and more memory, would contribute heavily to the sound of 1980s popular music, spawning new musical styles such as techno, hip hop and drum and bass.



The Fairlight CMI Series II featured an interactive CRT-based interface which allowed for rudimentary music sequencing through an application called Page R.

Page R allowed less-proficient keyboardists to program complicated “riffs”, while also allowing songwriters and composers to easily hear what their musical ideas might sound like in a complete arrangement.



THE WONDER FROM DOWN UNDER

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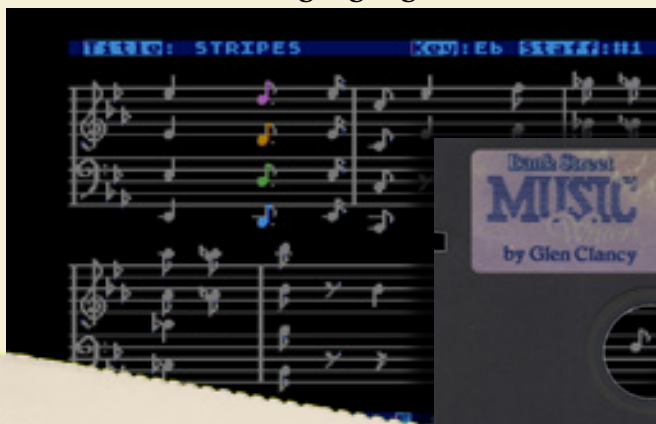
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But it really doesn't matter how you employ or enjoy your ATARI Home Computer. Because the combination of your talents and our computer is a winning team.



Bank Street Music Writer was a typical music application of the time. Written by Glen Clancy and published by Mindscape, the Atari version was released in 1985. Like competitors such as Music Construction Set, users can place graphical representations of notes on to a musical staff, making the creation of computer-generated music much more traditional than step-entry piano-roll type methods.

This was only practical due to the visual nature of a computer monitor, which wouldn't itself have been possible without the cathode-ray tube, the work of A.A. Campbell Swinton, Philo Farnsworth and many others. This sort of interactive music editing highlights the varied artistic software applications the CRT made possible, not just in visual arenas such as video, photography and digital art, but also in literature and music, where digital composition is a standard practice today.



The **Page R sequencer** in the Fairlight CMI Series II inspired a great many musician software developers to create versions for 1980s-era home computers, including the Atari 400/800, the Apple II and the Commodore 64.

While these **8-bit machines** were limited to simple waveform-based sound synthesis, and couldn't (generally) play back digital samples the way the CMI could, note-based sequencers provided not only a simple way to both learn music notation but also create 3-voice arrangements of original and popular tunes (and also Christmas carols!) with the noise channels in most sound chips providing primitive drums.

Considering the contemporary equivalent was the repetitive (and cheesy) accompaniment available in the common household electronic organ, this was considered to be an improvement!

Atari and Commodore both released note-based music software for their respective computers; Commodore's included a musical-keyboard overlay that went over top of the alphanumeric keyboard on its Commodore 64. A number of third-party software programs were also produced, and 8-year old music composers flourished.

ROY CASTLE

Whenever I think of Roy Castle, I think back to his TV series 'Record Breakers' and in particular to one program in which Roy attempted to play a record breaking number of instruments — and make music from objects that are far from being instruments in the true sense. It isn't everyone who can play a tune on a teapot!

So when we heard that Roy was now the proud owner of a 64 we couldn't wait to find out just what he was doing with it. Transforming it into a wind instrument? Or maybe using it for percussion!

Nothing that dramatic as it turned out, but Roy does find the 64 invaluable in writing music.



"It certainly doesn't replace real instruments," comments Roy. "What it does do is to allow you to very deliberately plan a musical arrangement and listen to it."

"It's a very good way of learning how to listen to an orchestration without trying to write it not knowing how it will sound. After all not many people can afford to employ a whole orchestra to listen to how it is coming on."

Commodore Computing October 1984



The **POKEY chip** inside the **Atari 800XL** provided **four square-wave** voices with the ability to **distort** them individually, instead of a **noise channel**. However it lacked the envelopes of the **AY-3-8910**.

COMPUTER ROCK & SCROLL

Computers are taking over the music scene. And software companies are jumping on the bandwagon to bring music software home to you!

Musicians—rock 'n' roll, classical, jazz, you name it! They're all leaping into the computer phenomenon—and bring it! Meanwhile, software manufacturers are making sure you don't miss out on the fun. There's loads of software out there for aspiring computer musicians and composers.

First, on the band scene, it looks like everybody's computing! There's Rolling Stones bass guitarist Bill Wyman, who's recorded the past two decades of his life on a computer. He recently completed a feature film called *Digital Dreams*. It's loosely based on Wyman's musical life and his addition to computers.

Rock star Todd Rundgren was into the computer scene before Wyman. In fact, he first turned Wyman on to computers in the late '70s. Rundgren, 30, first used computers for video work in late 1978, but now writes programs. He created the *Utopia* Graphics program, named after his band, and it's named it to Apple. The license has since lapsed, but he plans to improve the program and release it.

Rundgren isn't the only hacker in Chicago, though. The band's keyboard player, Roger Powell, is a consultant for Microsoft. Jonathan Berlin Haddock is into Apple II. He recently finished a solo symphonies album—in his garage. He successfully linked all of his

instruments together and played them from just one keyboard.

Some artists are making computer music without any computing experience. Guitarist Al DiMeola used a Fairlight CMI (Computer Musical Instrument) throughout *Scimitar*, his latest album, without any computer know-how. So what's all this got to do with you? Now, wonder of wonders, you can program an actual *Drum Machine* song into your computer, and play your own computerized song! Plus, you can read what Talking Heads' Tina Turner and Chris Frantz think of music software, and find out how 17-year-old Will Hersey designed *Music Construction Set*.

Music software for your computer

Anything is possible with the right hardware and the current music software. You can sing along to your favorite songs, or write your own hit rock and roll song! A list of some of the music software out there starts here and continues on the next eight pages.

ADVANCED MUSIC SYSTEM—Generate music by entering notes that can be played by each of the four voices. Can copy or play back. Comes with five sample classical pieces.

ATARIWORKS I and II—Learn how to read music through self-guided instruction, drills, and games. The first program teaches note reading and whole and half notes. The second program covers major scales and keys.

REQUIREMENTS: Atari 400/800/1300XL, 1MB (optional), 34K (disk).
MANUFACTURER: Atari, 1313 Constitution Dr., P.O. Box 4027, Sunnyvale, CA 94088, (800) 538-4543.
SUGGESTED RETAIL PRICE: \$39.95.

BAINCING BEATS—Compose your own melodies or play your favorite songs. Plays music with coordinating graphics. Won't let you hit a wrong note.

REQUIREMENTS: Atari 400/800/1300XL, 32K (disk), joystick.

8-bit music notation software led to the rise of the first "bedroom musicians", amateurs who were now able to compose coherent, sequenced tunes without the need for expensive equipment.

Many of them would go on to write music for video games, and/or became professional musicians when they became older — much like many of today's bedroom EDM producers, who use descendants of that software.



British computer magazine *Computer and Video Games* held a music contest for its "bedroom-musician" readers in 1984, whose compositions were judged by former Depeche Mode member Vince Clark, himself an extensive user of the Fairlight CMI. No pressure!



Vince Clark

Earlier this year, *Computer & Video Games* ran a micro-music competition and the man who judged all your musical efforts was Vince Clark, once part of Depeche Mode, half of Yazoo and mastermind behind the Assembly.

Vince can be found playing arcade games in Ireland and Brighton when he's not putting together a new of sounds on his Fairlight.

The Fairlight uses computer technology to "sample" sounds and recreate them electronically. Any sound can be stored away on the Fairlight's big disk and then loaded back into the machine when needed.

The Fairlight has eight channels, each of which can be programmed separately. So you can build up an entire song — music vocals — using this amazing machine.

Vince says he enjoys using computers when composing because he has overall and absolute control over the finished result. You don't have musical differences with a computer. The Fairlight gets to grips with a programmed sequence and plays



musical life of his father. In fact, he's recorded the past two decades of his life on a computer. He recently completed a feature film called *Digital Dreams*. It's loosely based on Wyman's musical life and his addition to computers.

Rock star Todd Rundgren was into the computer scene before Wyman. In fact, he first turned Wyman on to computers in the late '70s. Rundgren, 30, first used computers for video work in late 1978, but now writes programs. He created the *Utopia* Graphics program, named after his band, and it's named it to Apple. The license has since lapsed, but he plans to improve the program and release it.

Some artists are making computer music without any computing experience. Guitarist Al DiMeola used a Fairlight CMI (Computer Musical Instrument) throughout *Scimitar*, his latest album, without any computer know-how. So what's all this got to do with you? Now, wonder of wonders, you can program an actual *Drum Machine* song into your computer, and play your own computerized song! Plus, you can read what Talking Heads' Tina Turner and Chris Frantz think of music software, and find out how 17-year-old Will Hersey designed *Music Construction Set*.

The higher video resolutions available in 16-bit computers such as the Atari ST (640x400) and the Apple Macintosh (512x342) led to an improvement in the graphical quality of music software. The crispness of their monochrome CRT displays made musical notes more readable, and thus more of them were legible on screen at one time than had been on their lower-resolution 8-bit predecessors.

The Atari ST also featured a built-in MIDI interface, which allowed for the connection of external keyboards (for both input and output) and digital-sampled "sound banks" such as the Roland MT-32, which set the standard for MIDI instrument assignments and allowed for greater portability of MIDI files between different electronic musical instruments and devices.

HOME COMPUTER MUSIC

As they had with the Fairlight CMI, professional musicians began to take notice as consumer-grade computers developed complex music-notation and sequencing software.

Paired with MIDI instruments capable of outputting dozens of voices simultaneously, these consumer computers began to overtake dedicated musical computer systems such as the Fairlight CMI, with the Atari ST (commonly paired with Steinberg's Cubase music sequencing application) becoming fairly standard in music studios around the world for much of the 1990s.

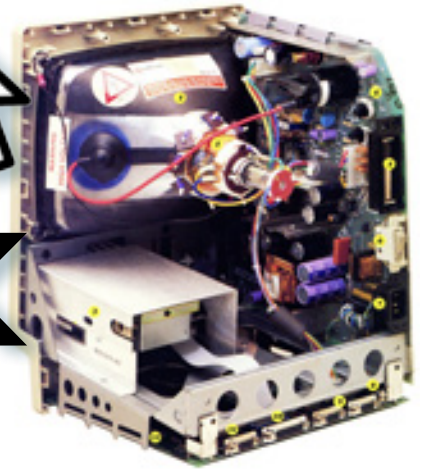
These days, most music is sequenced using an off-the-shelf Macbook Pro!





Point & Click

Welcome to
Macintosh



A large, rectangular canvas bag sits in the middle of a huge oaken conference table, a gaggle of journalists assembled around it, while Steve Jobs talks Walkman.

Apple worked to provide a user interface so simple you don't have to think about it, and they wanted the physical appearance of the computer to be equally unobtrusive; Macintosh occupies about as much space on a desk as a standard yellow notepad. It can easily stay out of the way when you don't need it, and at 21 pounds, it can just as easily go where you want it to.

PERSONAL COMPUTING February 1984

"It's amazing", Jobs says, "only about that thick." He gestures with his thumb and forefinger to describe its width. "The limit was how thin they could make the cassette drive mechanism." Jobs is, of course, attempting to segue into his own innovation, sitting in the canvas bag, but the journalists are impatient, and Jobs quickly

surmises that this time, he's not the object of their affections – what's in the bag is.

"Let's not keep you waiting any longer," he says, flipping open the bag, and pulling out the conclusion of four years of his personal direction, plopping it on the table. He looks for something, and realising where it is he strides over to a side table, picks up a flat plastic square and tosses it uncaringly at the device on the table, which looks like some sort of portable television.

That portable television was the Macintosh, an integrated 16-bit computer, floppy disk drive, and 9-inch (23cm) CRT monochrome display. The year was 1984, and Apple was just about to launch their new product, an all-in-one compact personal computer, an effort to erase the hardware paradigm with the public and leave only software.

MACWORLD
Premier Issue \$4.00
Canada \$5.75
The Macintosh Magazine

Macintosh

Apple's Remarkable
New Personal
Computer



An Exclusive
Look Inside the
Macintosh

Word Processing
Tips for
Mac Writers

MacPaint's
Amazing
Electronic
Easel

The Graphics

It's best to consider the graphics first, because most of Mac's attributes stem from what's become known as Lisa Technology. As generally defined, Lisa Technology features a high-resolution, bit-mapped video display, a desktop metaphor, and a mouse for control. In Macintosh, the display is 512 dots by 342 dots—extraordinary resolution on such a small screen.

Two results of that resolution are immediately apparent. The first is the clarity of graphic images on the screen. The second is the detailed nature of screen dumps from the video display. No computer except Lisa can match Mac in those two areas.

The sharpness of the video images is necessary to carry off the desktop metaphor. The desktop metaphor is central to the attempt to bring personal computing to the layperson. Representing computer actions and everyday actions in visual form makes the process more understandable. The pictures that stand for everyday items or actions on a desktop are called icons, and work is done by manipulating them.

ST.Mac February 1984

"Take it to work during the day, bring it home for the kids at night," was Apple's marketing pitch – good for business, great for learning, excellent at anything you could ever want a computer to do, the Macintosh was meant to be the first computer appliance, something that you just plugged in and it worked, with no need to read a complicated technical manual in order to use it.

At one-quarter (US\$2500) the cost of the US\$10000 Lisa, the Macintosh's predecessor, Jobs hoped that his machine would become as common as, well, Walkmen. With its sophisticated GUI (Graphical User Interface), he was confident that anyone could learn how to use it, and that everyone who did would swear they didn't know how they ever got along without it.

The star of the Macintosh show was arguably its cathode-ray tube display.



Apple's challenge is called Macintosh. The new computer, introduced on January 24, is a little box with a different monitor, a different keyboard, a different disk drive, different interfaces, and different software. It doesn't look quite like anything we've ever seen, and it doesn't work quite like any computer we've ever used. It challenges our assumptions, not just about what computers are and how we use them, but ultimately asks us to rethink the way we work.

PERSONAL COMPUTING February 1984

Macintosh Goals

by Gene Wilson

Apple Orchard

Macintosh is the culmination of over 400 man (person) years of technological and humanistic development. Lisa was last year's sweetheart, and it makes sense that Apple would create an entire family based upon the fruits of all that labor.

The real challenge confronting Apple management was to produce the "Lisa Technology" on such a massive scale, at such a reasonable and affordable price, that it would be made available to millions of persons; a marriage of hardware, software, proven technology, and innovation that would bring those people who'd so far ignored the "computer revolution" into the marketplace. In a nutshell, the goal was to recreate the "Apple II" story all over again.



THE SOUL OF A NEW APPLE



Burrell Smith, who started in Apple's service department, was head hardware designer on the Mac project.

Steve Jobs may have liked to take the credit for the Macintosh, but its motherboard was the result of another hippy's creative genius, that of Burrell Smith. A member of the Home Brew Computer Club along with Steve Wozniak back in 1976, he turned up in '79 at Apple HQ looking for a job, and got one - in the service department. But his talents would not go unrecognised for long, soon landing on the Macintosh team.

The 16-bit architecture of the Macintosh's computer circuitry also made those fancy fonts and icons quite speedy, dispensing with the need for a generic "text mode" altogether. Text was just graphics now, rendered on-screen just as swiftly as icons, halftone images (also typical to the newspapers of the time) or anything else. Fonts (aka typefaces) could be anything - serif (New York), sans serif (Chicago), novelty text like San Francisco or even symbols like Cairo.

Thanks to the high-resolution monochrome CRT display, a whole new world of desktop publishing became possible.



Sure, the mouse was certainly way up there in the billing, but what good is a mouse if you can't see anything? The whole box of tricks becomes nothing more than just a very expensive box once you tape a square of cardboard over the screen!

But why build the screen into the computer? Sure, portability is one thing, but couldn't you just have a monitor at home and a monitor at work? Problem solved! Well, the only problem with that was that monitors in 1984 were largely simple "composite" displays - which were basically just televisions without the ability to tune-in TV stations. They also had the same number of horizontal scan lines, which was fine for the low-resolution output of contemporary 8-bit computers such as the Commodore 64, but insufficient for the GUI of the Macintosh.

For detached monitors to work in the described scenario (work/home) you would need to buy two special Macintosh monitors - that would add a fair amount to the price, and consumers weren't fond of the idea of buying what many of them saw as a TV which could only be connected to one thing. No, the only way to really resolve the argument was to build the monitor into the computer. You want a Macintosh? This is your screen, period.

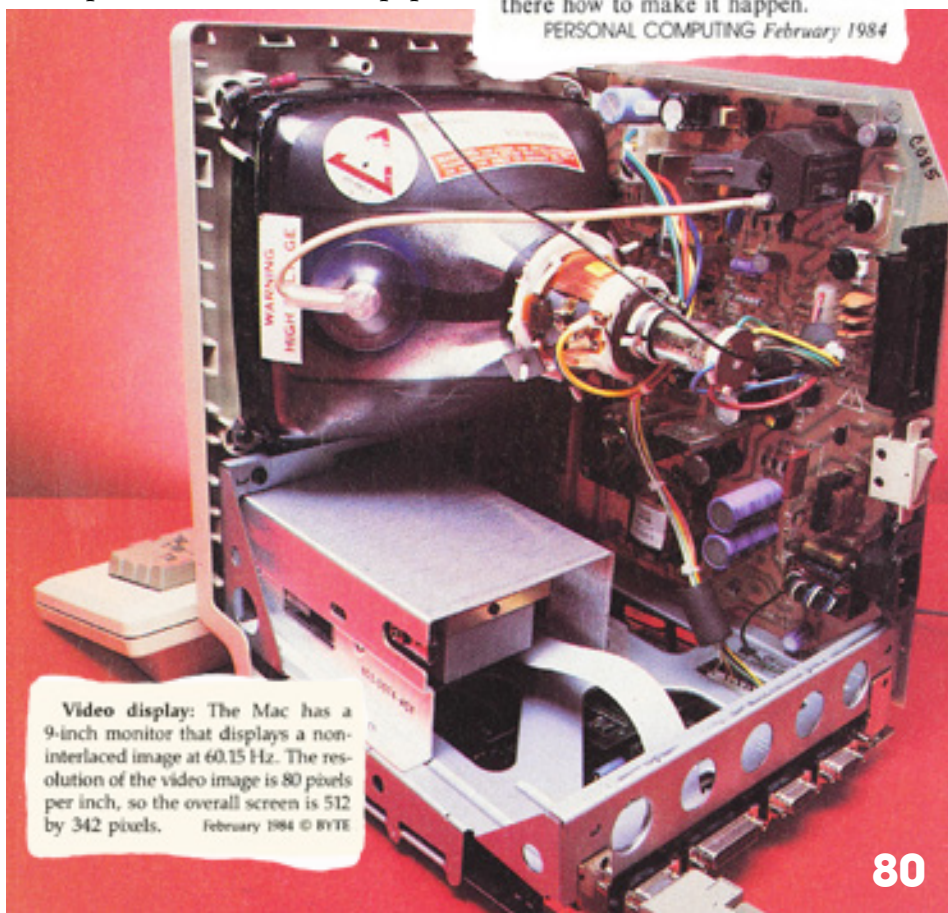
Not that that was a bad thing. The newfangled concept of icons (picture representations of real-world objects, such as a pencil or a piece of paper) worked well with the Macintosh's monochrome high-resolution display, the crisp contrast between its black and white pixels making text stand out like no other computer available at that time could. While other computers had white (or green, or orange) text on a black screen, the Macintosh had black text on a white background, just like a printed book or a newspaper.



Macintosh makes computing power as easy to use as a telephone.

If it seems odd to be talking about some hunk of plastic, metal, and glass this way, it's because as a product, Macintosh is part hardware, part software, and part philosophy. It's as if Apple had this idea of some super-easy, super-smart Volkcomputer that would make tremendous computing power as easy to use as a telephone, and then figured out from there how to make it happen.

PERSONAL COMPUTING February 1984



Video display: The Mac has a 9-inch monitor that displays a non-interlaced image at 60.15 Hz. The resolution of the video image is 80 pixels per inch, so the overall screen is 512 by 342 pixels. February 1984 © BYTE

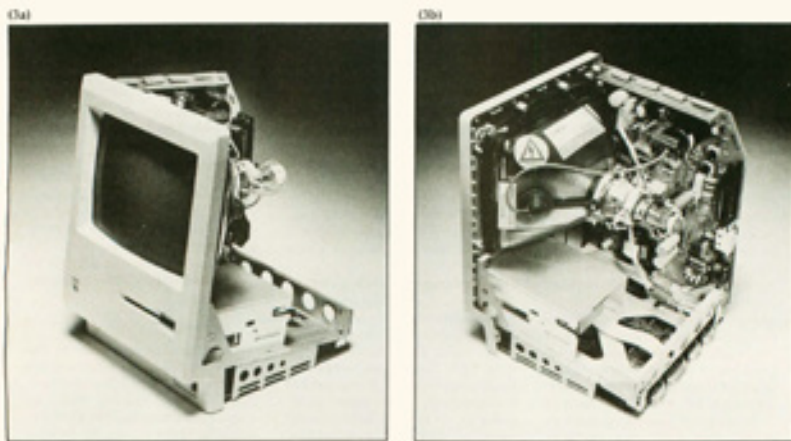


Photo 3: Inside the Macintosh computer. From the front (photo 3a), you can see the video display and the 3½-inch disk drive. From the rear (photo 3b), you can see the two main circuit boards (right and bottom), the rear of the video-display tube, the 3½-inch disk drive, and a row of connectors at the bottom of the unit. The connections go, from left to right, to the mouse, a second disk drive, two peripherals (there are two serial ports), and an external amplifier (for sound output).

38 February 1984 © RYTE Publications Inc.

However, at the Macintosh's launch, only a dot-matrix printer, called the ImageWriter, was available. While the ImageWriter was fine for home and school use, its print quality was too poor for the publishing industry. Steve Jobs recognised this and negotiated with Adobe Systems to license their PostScript protocol, a vector-based programming language that when combined with a laser printer allowed for the rasterisation of fonts at a high-resolution – visually equivalent to traditional mechanical typesetting.

While the quality was superb, the new printer, dubbed the LaserWriter, was expensive, given that to drive the rasterisation process required an even faster CPU in the printer (a 12mhz 68000) and more memory (1.5 megabytes) than was in the Macintosh! Nevertheless, people saw the potential, and a cottage industry in digital “desktop” publishing sprang up around North America overnight, with small companies providing even smaller businesses with

The GUI interface allowed for a WYSI-WYG (What You See Is What You Get) design flow, making digital typesetting a straightforward process with few surprises (although these were still possible, such as when the LaserWriter ran out of memory!) The Macintosh's monochrome display was no problem in an era where print publishing was mostly black and white.

Macintosh allows us to forget about the physical computer and concentrate on our computing.

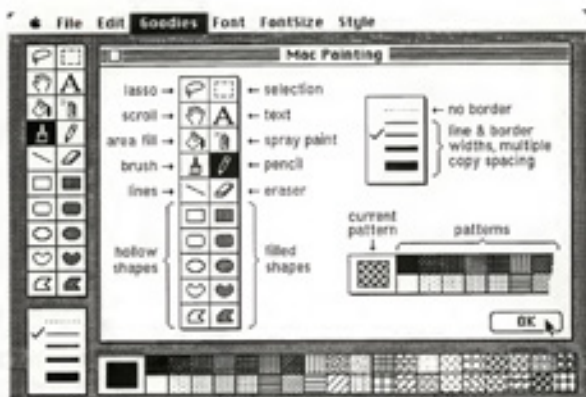


Figure 1: The MacPaint application window from the Macintosh provides a quick reference to the MacPaint features.

MacPaint is the electronic equivalent of having top-flight artist's tools and skills at your fingertips.

“Screenshots” in the 1980s were literally shots of the screen – a light-blocking horn was fitted to the front of the CRT, with a film camera inserted into the narrow end.

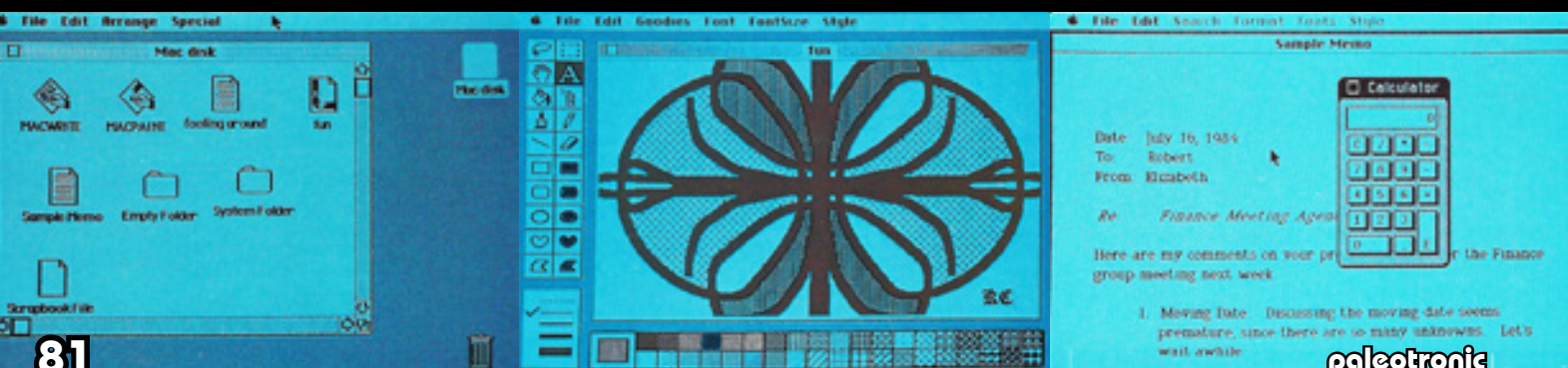
print and design services they had previously been priced out of, given that mechanical presses had heavy “front end” costs and required runs of large numbers of copies to be financially practical.

“Paint”, word processing and layout software enabled savvy Macintosh users to create fresh-looking print designs with relative ease, and in a short amount of time, with the largest delays incurred in the process coming while printing to the LaserWriter – also known as a “coffee break”, as the computer could do nothing else during this time, and the communication with the printer was very slow, taking several minutes to render a complex page.

But compared to the expense of old-school publishing methods, these new desktop-publishing houses could charge a great deal for their services while still looking like a bargain, and this new industry was instantly profitable and flourished.

The screen measures only 9” on the diagonal, but you’ll forget all about the smaller size when the computer comes on. This display is so sharp and clear that you’ll forget you’re looking at a computer. It looks *cooler* than a standard green or amber display, and you won’t find yourself squinting as much to see details because everything’s so sharp.

February 1984 PERSONAL COMPUTING



Speaking of CRTs...



1984

George Orwell's dystopian 1949 novel about a bleak future world ruled by a fascist dictatorship became the inspiration for the 1984 commercial announcing the [Macintosh](#).


In it, a female track athlete (a reference to the 1984 [Summer Olympics](#)) wearing red shorts and carrying a hammer is pursued through a monochromatic industrial setting.

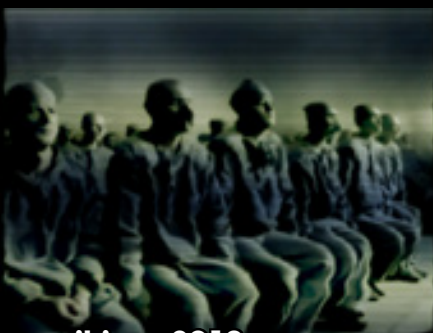
The scene is populated with drone humans obeying the commands of a man appearing on omnipresent CRT screens, representing "[Big Brother](#)", the repressive authority from Orwell's novel.

Chased by the "[thought police](#)" the athlete runs up to a larger, cinema-sized CRT screen, where she throws her hammer through it, while Big Brother talks of the benefits of conformity.

The "conformity" portrayed in the commercial thinly alludes to the growing contemporary dominance of the [IBM PC](#) and its increasing numbers of "[clones](#)" – compatible computers made by other manufacturers.

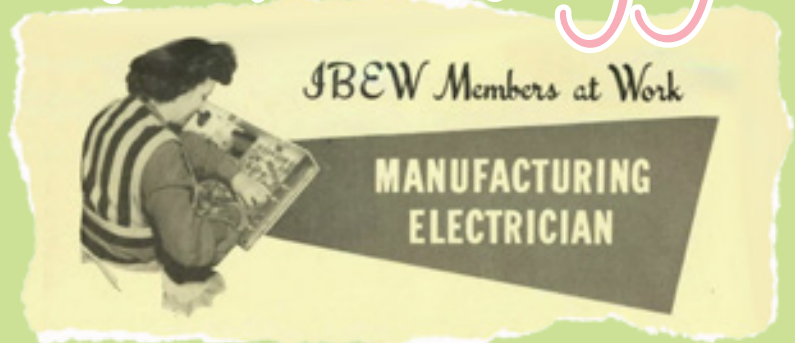
The suggestion is that the Macintosh will end that domination. However, history will prove that prediction wrong, with the PC and its descendants going on to rule the [personal computer](#) industry well into the present day.

Famously airing during the 1984 [Super Bowl](#), the commercial, directed by [Blade Runner](#) filmmaker [Ridley Scott](#), drew critical acclaim. But the broadcast almost didn't happen, when Apple CEO [John Sculley](#) tried to pull the commercial due to the objections of Apple's [Board of Directors](#). 



Women in Technology

During the Second World War, American women were recruited to fill factory roles previously occupied by men who had gone off to fight in Europe and in the Pacific. While many of these roles involved the manufacture of munitions, others involved the assembly of electronic components used in field radios and other equipment. These women were found to have greater dexterity and paid greater attention to detail than the men who had preceded them.



With Television Builders in Chicago



L. U. 1031 Members at Work

Photos on this page were taken in the plant of Admiral Radio and Television Corporation, Chicago. Above, TV chassis start their long trip down the assembly line. In circle, Marie Markiewicz rivets angles to a TV chassis in a sub-assembly area. At left the sets, after passing through 83 sets of hands, are almost ready for inspection. At lower left, sets are checked after coming off assembly line. Below, workers are shown installing 12-inch cathode ray tubes.



Page Two

The Electrical Workers' Journal for April, 1949

After the war had concluded, American companies returned to manufacturing domestic appliances, including television sets. However, the male workforce they had employed before the conflict had since diminished due to wartime casualties, and those who returned had fallen out of practice.

But there was a large surplus of recently experienced female employees who could be easily trained to take up those roles, and companies such as Admiral didn't need much convincing to engage that workforce in their factories.

Women filled virtually every available role in the assembly of television sets, save the final calibration of the picture tubes, which required very sophisticated knowledge of electronics and employed some men. Over 80 women would lay hands on each and every television set, doing all of the wiring, soldering, assembly and testing – apparently with much greater reliability and productivity than their male counterparts had a decade before.

Admiral was delighted with their majority-female workforce, which helped them to cut costs and market televisions more cheaply, aiding in their proliferation into American households. However, as women were encouraged by the US government to have children and replenish the population, they gradually left the workforce during the “baby boom” of the 1950s, largely becoming stay-at-home mothers, and not returning.

(Below) A female factory employee uses a suction cup to affix the front glass to the cone of a television cathode-ray picture tube.

government to have children and replenish the population, they gradually left the workforce during the “baby boom” of the 1950s, largely becoming stay-at-home mothers, and not returning.



On Assembly Line

The 1,200 I. B. E. W. women employed in this plant, work on the five assembly lines and in various sub-assembly lines. Due to the current shortage of cathode ray tubes (on which the TV owner views the broadcast image), only four of Admiral's five main assembly lines were in production at the time of the JOURNAL reporter's visit. Each of the four lines produces about 250 sets a day. Approximately a hundred I. B. E. W. male members work on the final inspection line and in the "tracking" booths, where the various television channels are calibrated.

Starting at the beginning of a line as no more than a bare chassis, an Admiral television set passes through the hands of 83 women before it reaches the end of the line and becomes ready for insertion of the cathode ray tube.

Early television sets were made up of the housing, usually made of wood, a power chassis which provided high voltage for the picture tube and DC (direct current) voltage for other components, a tuner which isolated the signal channel (often part of the channel dial assembly), an audio chassis which decoded the audio signal and amplified it, sending it to a loudspeaker, and a video chassis, which decoded the video signal and drove the various parts of the cathode-ray tube in order to display the image.

A factory was made up of multiple assembly lines, each either manufacturing a component, such as the CRT or the video chassis, and a final line that assembled those components.

Bowling is the most popular sport among plant workers, and several intra-company teams are continually battling for first place. In the summer, women's softball teams flourish.

Intricate wiring and soldering operations comprise the bulk of the work on the main assembly lines. In the sub-assembly areas, more of this type of work takes place. There also is a certain amount of drill-and punch-press work, and one large room, employing 50 girls, is given over exclusively to the preparing and tinning of wires.

While the long hours on the assembly line were repetitive and tiring, factory life was not entirely without recreation, with company sports teams competing against each other for trophies.

A Television Assembly Line

On an assembly line, each worker is responsible for one task involved in the assembly of a product or device. Before the Industrial Revolution, most items were assembled by one individual, from parts they – or a small team of which they were a part – made themselves. However, this was time-consuming and expensive, and methods were found to streamline the manufacturing process, first by specialising workers on particular segments of the production process, and later by more efficiently moving parts and partially-assembled products between them.

The most famous early example of a modern assembly line was at the Ford Motor Company in Michigan. Ford employee William Klann was inspired by his visit to a Chicago slaughterhouse, where carcasses moved along a conveyor belt, and each employee only removed one part. Ford developed an assembly line for its Model T car, which cut manufacturing time significantly.



Finally, the entire unit would be tested for quality control purposes and any defects troubleshooted and repaired. The finished product would then be packed away for shipping to department stores and retailers.

The efficiency and compartmentalised nature of the assembly line allowed for the "electronics revolution" and the world we live in today.

Pem Farnsworth

Born in 1908, Elma "Pem" Gardner was attending high school in Provo, Utah when she met Brigham Young University student Philo Farnsworth, who she would eventually marry.

Philo frequently remarked over the ensuing years about how involved Pem was in the development of "his" television system, crediting her with providing a great deal of useful input involving its design. However, she was never one to take that credit.

Pem and Philo Farnsworth (left)



PAY TV

While the advertising model adopted by free-to-air television more than covered station-owners costs, media companies have always searched for solutions aimed at getting viewers to pay for programming directly.

Telemeter was one such solution. An early cablevision service, coaxial cables were run to households who wished to be connected to it. Reception of local free-to-air stations over the cable was provided for a monthly fee.

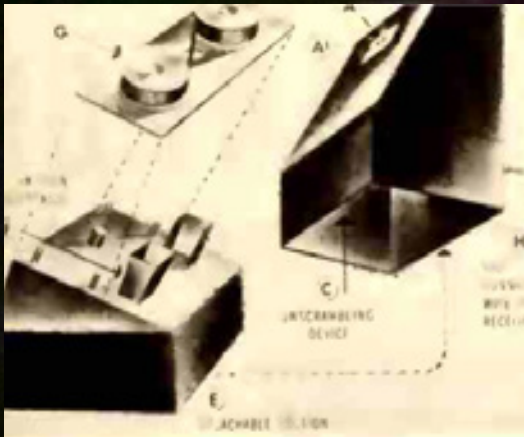
Three additional channels were also available, which were scrambled. Telemeter customers could get a descrambling box installed, but instead of paying a monthly fee, the box was coin operated.

Part-owned by movie studio Paramount, Telemeter was trialled in Palm Springs, California, in 1953. Customers could put

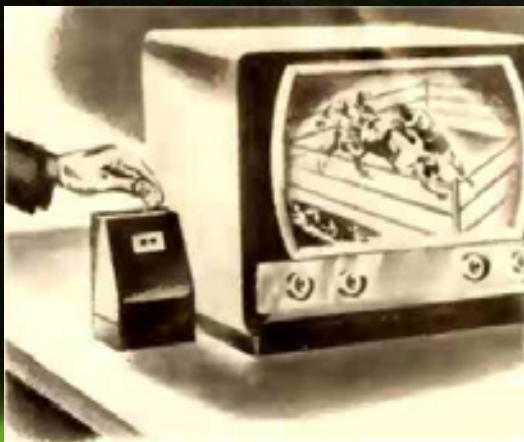
US\$1.25 into the box to watch first-run films and sporting events, such as boxing. However, local theatre owners became extremely unhappy at the prospect of competing with the service, and it was shut down after just six months.

Nearly five years later, in 1959, Telemeter started up again, this time in Ontario, Canada, outside the reach of the US Federal Communications Commission (FCC) which at the time was staunchly against pay-television services.

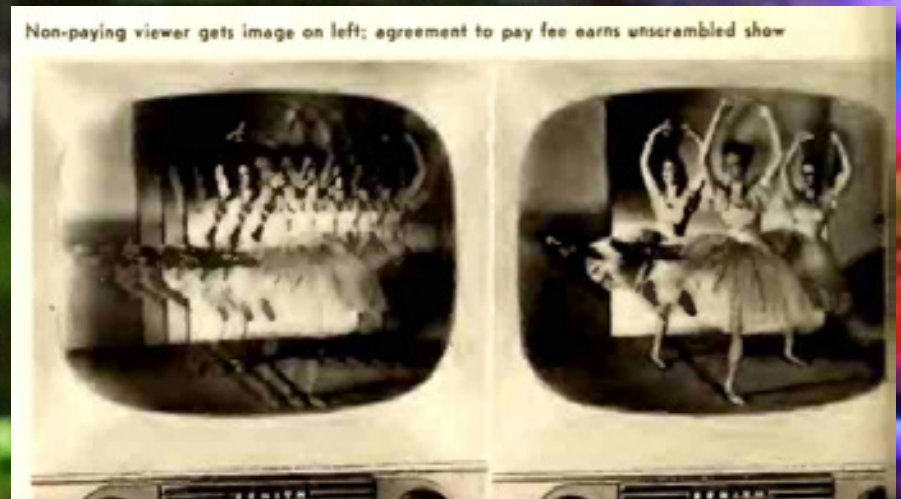
It launched with one thousand subscribers, once again showing first-run movies and commercial-free TV shows.



Exploded view of Telemeter gadget shows how it works: User looks in window (A) to find cost of show, inserts in coin slot (B) required amount. This activates the unscrambling device (C) inside box. Window (A-1) adds coins as inserted. Detachable section (E) consists of two parts, coin receptacle (F) and electronic tape (G) which records, for distribution purposes, shows paid for.



Inserting coins in Telemeter unscrambles picture of event being shown, permits viewer to see movies, sports activities, or special programs. Gadget does not interfere with normal reception on regular commercial channels. Backed by Paramount Pictures, device is claimed ready for commercial operation. Variation in price of shows will be from 5c to \$2.00.



Non-paying viewer gets image on left; agreement to pay fee earns unscrambled show

1950s

\$1 PER SHOWING FOR FILMS



Telemeter coinbox shown above collects from \$1 for feature films down to 25¢ for children's shows from home owners in Toronto suburb, where pay tv has close to 6,000 installations



In 1961, Telemeter signed deals with two Toronto sports teams to broadcast their games; Broadway shows and opera productions also made appearances on the system.

However, although at its peak it had 5800 subscribers, Telemeter was deemed commercially unviable and was never expanded to other cities. It was shut down in early 1965.

While Telemeter wasn't a success, it was the first system to introduce pay-per-view services into cable-based television broadcast systems. It wouldn't be until 1972, with the launch of HBO, that premium television services would return to channel dials and remain.



GEEK

DESCRAMBLING

Scrambled signals teased basic cablevision customers – visible in the channel lineup of their cable boxes (and often with unscrambled audio) they were virtually unwatchable.

Premium cable channels like HBO, Showtime and Cinemax in the United States; and SuperChannel in Canada aired second-run movies, comedy specials and sporting events starting in the 1970s. Cablevision companies would rent a second “cable box” to customers that descrambled the channels for an additional monthly fee, which could easily double or triple a customers cablevision bill.

Not surprisingly, most people opted out of the service, unable to stomach the extra cost, but the channels’ lineups were prominently listed on computer-generated TV schedule channels, and grated on viewers only able to watch commercial-filled programming.

A dubious justification soon emerged: since the scrambled signal came in to your house arbitrarily (or through the air, in the case of satellite TV), you were well within your rights to do whatever you wanted with it, including descramble it. Generally law-abiding people began to build descramblers.

LETTERS

TV DESCRAMBLING BOOK

In the November installment of our series, “TV Signal Descrambling,” you were kind enough to note that we are preparing a book dealing with the same subject. The correct title is *Video Scrambling and Descrambling for Satellite and Cable TV*, catalog number 22499.



TV-SIGNAL DESCRAMBLING

After reading the current articles on TV Signal Descrambling, the elaborate and esoteric methods used to keep a few hackers and those in the hinterlands from seeing the broadcasters’ emanations, my question is: Why?

A review of this week’s offerings from the birds on my local cable, from “Frackle Rock” to 40-year-old movies played for the 17th time this year, leads me to the conclusion that the general public mentality is even lower than the network executives think it is.

My major concern is this: With the cable companies and bird operators finding out that there is little market for their garbage, and with the encoding so simple and foolproof, the next thing is that pay-TV will move to the local HF-VHF stations and we will have to rent a decoder to see “Miami Vice” and David Brinkley. And will the

LETTERS

EDITOR: ELI C. FORTMAN
300-B AIRCRAFT DRIVE, SUITE 100
FARMINGDALE, N.Y. 11735

HURRAH FOR CAPTAIN MIDNIGHT

I read your article, “The Raid on HBO,” in the October 1986 *Radio Electronics* with much interest.

In my opinion, someone should have given “Captain Midnight” a medal for being so brave. The only reason I myself didn’t do something like what he did is that I don’t know enough about satellites. I feel that the people who scramble programs are stealing not only from those who receive the program but from those who pay for the ads on the program.

You see, I am a rebel. Back before many of you were born, I was in radio. That was back in the 1930s; as a teenager, I thought it was wrong for the government to tell me that I couldn’t have a broadcasting station. The government doesn’t own the airwaves—they belong to God. So a friend and I built a

1980s

But how did they do that? Well, to explain descrambling, first we need to explore how the signal is scrambled, or encrypted.

Most early television encryption systems worked by modifying the electromagnetic signals that make up the audio and video portions of a television channel (see *Radio Waves* for more information). To review, a video signal has both horizontal and vertical synchronisation pulses which tell a television set when to advance the electron gun to the next line, or frame of video.

The earliest systems modified these pulses so that they couldn’t be recognised by the television directly – either by suppressing them or relocating them to a different frequency – and instead of displaying a coherent picture, the TV would instead serve up a jumbled mess. By disrupting the sync pulses, other crucial information such as the colourburst signal was also lost, making a true dog’s breakfast of the image.

A pay-TV decoder box converted the modified signal back into the original by reversing what the encoder had done, restoring the sync pulses and making the rest of the signal legible to the television’s video circuitry once more. On systems where the blanking pulses were hidden, it was a simple matter of knowing where to look. But what if they were removed entirely?

CIRCUITS

TV SIGNAL DESCRAMBLING



This month we show you how to build and align a gated-pulse decoder.

WILLIAM SHEETS and RUDOLF F. GRAF

Part 7

LAST MONTH we looked at a practical decoder for the microwave scrambling system. This month we look at another practical descrambler. It will decode the gated-pulse system.

Gated-pulse descrambler

The popular gated-pulse system operates by suppressing the sync-pulse level so that the amplitude of the video signal is higher than that of the sync tips. That throws off the TV’s sync circuit, which is designed to assume that the highest amplitude signal is the sync. The result is a picture that rolls, tears, and is generally unwatchable.

A 15.734-kHz reference signal is used to resynchronize the sync. That signal is modulated onto the channel’s audio carrier, which is located 4.5 MHz above the video carrier frequency. The audio signal may be scrambled or unscrambled. If scrambling is used, it is done by suppressing the audio from the main audio channel and locating it on a 35.5-kHz subcarrier.

In order to decode a gated-pulse signal, we have to restore the correct sync-to-video-amplitude relationship. The circuit shown in Fig. 1 does just that. Let’s see how it works.

The scrambled signal is fed to jack J1 and coupled to IC1, an MC1390 variable-gain IF amplifier. The gain of that stage is

determined by the instantaneous voltage at pin 5. Maximum gain, about 20 dB, is achieved when that voltage is +5 V. Raising the voltage at pin 5 causes the gain to drop. For instance, at +6 volts, gain drops to about 12-14 dB. That feature of IC1 gives us a way to restore the proper relationship between the sync and the video. That is, raising the gain of that stage during the sync pulses will cause the peak sync tip-to-base again have a higher amplitude than the peak video. Gain is raised by applying a negative-going pulse to pin 5.

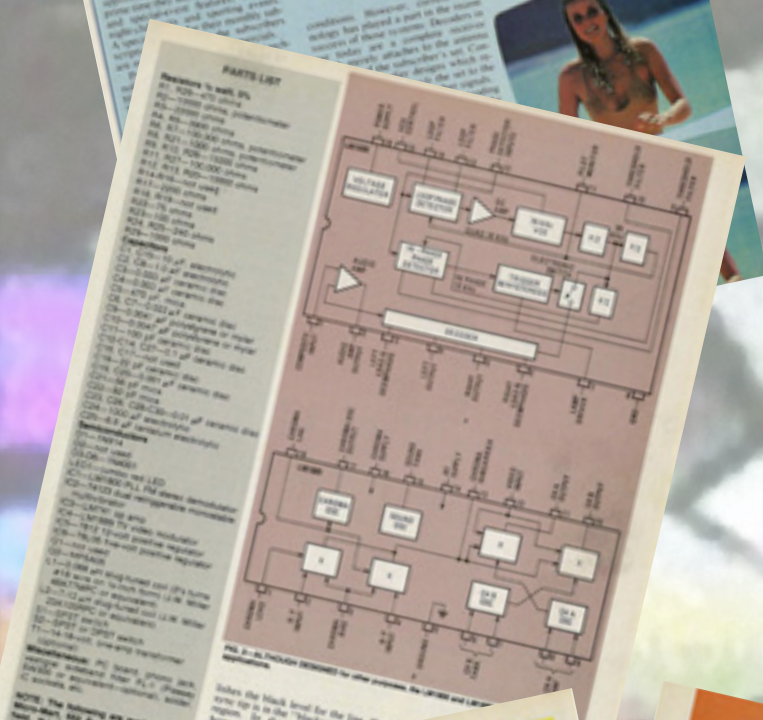
The majority of the decoder’s circuitry is used to generate the required pulses. A portion of the amplified RF signal, taken from the output of IC1, is coupled to IC2, an MC1330 video-detector/amplifier. That IC has a gain of about 30 dB. The output, at pin 4, is a scrambled video signal. That signal is fed to IC4, an MC1350 TV-sound IF amplifier. Among other things, that IC functions as a quadrature FM detector and a limiter. The 1.2-CF network is used to tune the detector to 4.5 MHz.

Remember that the decoding reference signal is modulated onto the 4.5-MHz sound carrier. It is extracted from the carrier using an MC1345 FM stereo PLL demodulator, IC3. That IC contains a PLL, audio demodulators, a pilot-carrier output, and a stereo-lamp output, which is used as a pilot-carrier detector here.

The audio signal appears at pin 12 of IC4 and is coupled to IC5 via a high-pass filter (C27, C28, R18, and R19). Resistor R20 and R21 are used to determine the frequency of IC5’s internal VCO. By varying the setting of R23, the VCO should be made to run at 4 times the horizontal frequency, or at approximately 63 kHz. When that is done, a 15.734-kHz signal appears at pin 10. That signal is amplified by Q1 and passed to IC6, a CD4052B dual monostable multivibrator.

The dual monostable handles the task of generating the missing sync pulses. The signal at the collector of Q1 is fed to one monostable at pin 4. That monostable generates wide (30 to 40 μ s) pulses, with a repetition rate of 135.734 kHz, at pin 13. That pulse train is used to trigger a second monostable multi-vibrator (pin 12) which generates a narrow 10- μ s pulse every 63 μ s. The network consisting of R33, R34, and C34 sets the pulse width of the first monostable; the network consisting of the 10- μ s pulse generated by the second monostable by varying the length of the pulse generated by the first monostable. Therefore, we can place the 10- μ s pulse anywhere we want during the video line

UNDERGROUND



Well, there was someplace else the synchronisation signals could be found – in the audio signal. But to understand how that could be, we need to take a brief detour somewhere else.

Stereo FM radio works by broadcasting a primary frequency-modulated monophonic signal (made up of the combined left and right channels of a stereo audio program) so that monophonic FM radio receivers can still reproduce it as if it were a non-stereo FM signal.

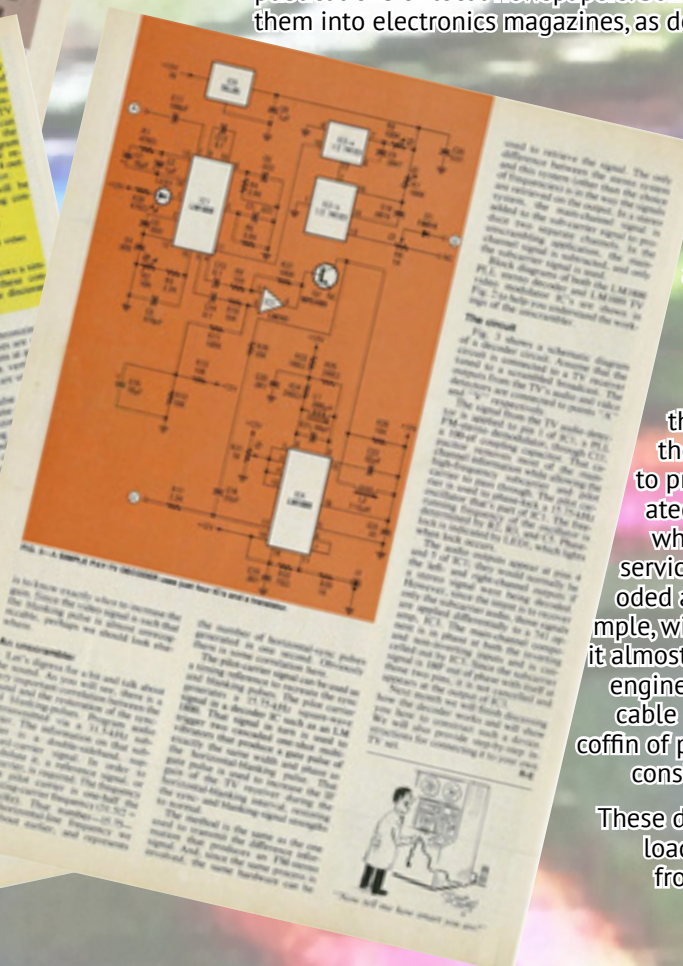
Embedded in that signal is a “pilot tone” at 19Khz which tells a stereo FM receiver that there is additional information on a frequency at double that number (38Khz) which contains a signal made up of the left channel **minus** the right channel and allows for decoding of both frequencies back into a stereo signal.

Multichannel Television Sound (or MTS) uses a similar system to add additional audio channels to a television signal – and most pay-TV channels had stereo sound. However, it encodes that information at 31.5Khz instead of 38, and has a pilot tone at 15.75Khz.

Happily, the horizontal sync rate in an NTSC television signal is 15.75Mhz – 1,000 times the MTS pilot tone! So by using circuitry common to FM radio receivers, we can extract the pilot tone and use it to recreate the horizontal sync pulse needed for a stable picture.

This is what the pay-TV box from the cable company did. It was a form of “security by obscurity”, where the only thing preventing people from violating it was the knowledge of how it worked. It only worked as long as the secret stayed secret, and despite non-disclosure agreements keeping people employed in the pay-TV industry quiet, it wasn’t long before technically-minded people reverse engineered the boxes to divine their mysteries.

Once they had, a booming market in pirate pay-TV decoders sprang up, with the devices available by mail order through addresses listed in the classified section of amateur radio publications or local newspapers. Some even sent plans for them into electronics magazines, as demonstrated here.



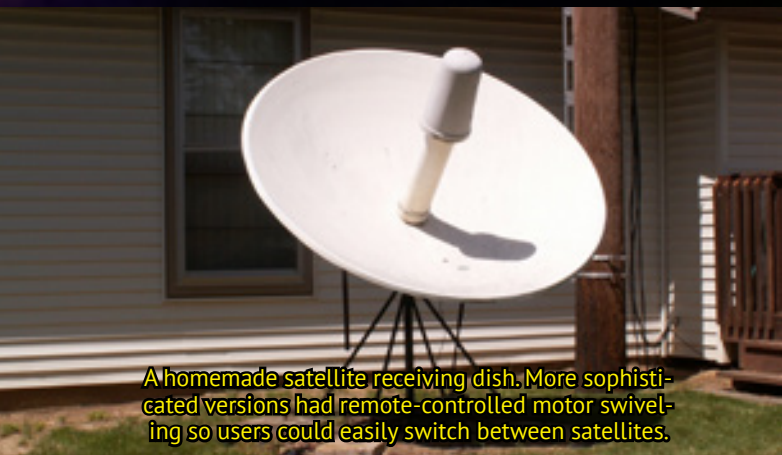
At first cable companies ignored “pirate” subscribers, with no defence against nor ability to detect them, but as it became obvious more and more people were using “illegal” decoder boxes, they placed pressure on the equipment providers to produce more sophisticated equipment to thwart what they called “theft of service.” Later systems encoded audio digitally, for example, with encryption to make it almost impossible to reverse engineer. Finally, fully-digital cable put the last nail in the coffin of pirate pay-TV decoders, consigning them to history.

These days, people just download pay-TV programming from the Internet... (Bad!)

Another way to avoid paying for channels like HBO in the early 1980s was to buy a satellite system, but pay TV operators didn't tolerate it for long...

In the 1970s, as cable TV proliferated and specialty cable-only channels began to appear, satellite television engineers started to build their own personal receiving stations so that they could acquire (and watch) these channels the same way their local cable company did, from communication satellites orbiting the Earth.

There was no subscription required – these channels were broadcast “in the clear” and anyone with a satellite dish and the required equipment could receive and watch them. Some enterprising individuals began to sell satellite systems commercially to homes and businesses.



A homemade satellite receiving dish. More sophisticated versions had remote-controlled motor swiveling so users could easily switch between satellites.

HBO became aware of the jamming and attempted to override John's signal by increasing their transmission power from 125 to 2000 watts, with John increasing his power in response. But after 90 seconds John gave up, becoming concerned the battle could damage the satellite.

He went home, thinking that nobody would have cared about his antics outside of HBO, but was surprised to see the incident covered on network news programs the following night. HBO complained to the US Federal Communications Commission (FCC) which eventually tracked John down. John feigned innocence but was charged and pleaded guilty to illegally operating a satellite transmitter. He was sentenced to a year's probation and fined US\$5000.



The message HBO viewers saw during the period MacDougall hijacked the satellite.

One such individual was a man named John MacDougall. John had left college after two years of studying engineering, and made a living installing satellite systems in Ocala, Florida. In 1983, he opened his own satellite dealership, which did well for the first few years, but then on January 15th, 1986 HBO, which had turned a blind eye to home satellite users up to that point, started to scramble their satellite signal.

While HBO offered to sell descrambling equipment to home satellite users, they weren't interested in paying for it (if they had, they wouldn't have installed a satellite system!) John's business was decimated overnight, as sales evaporated. He tried to cut his expenses, but ended up taking a part-time job with a satellite uplink company (which “uplinked” video to satellites for distribution to receiving stations).

Frustrated that he was very quickly going broke, he decided to use the uplink facilities to protest HBO's policy. After testing his ability to override HBO's signal early in the morning when it wasn't noticed, at 12:32am on April 27th 1986 he “jammed” a telecast of the 1985 film “The Falcon and the Snowman” for four and a half minutes.



The satellite McDougall hijacked, Galaxy 1 was launched in June of 1983.

THE ADVENTURES OF CAPTAIN MIDNIGHT

Paleotronic had a chat with prolific teletext artist Steve Horsley, aka **Horsenburger**, about how and why he got into teletext art.

Thanks for agreeing to answer our questions! When did you first encounter teletext? What system was it? What did you think of it, and what did you use it for?

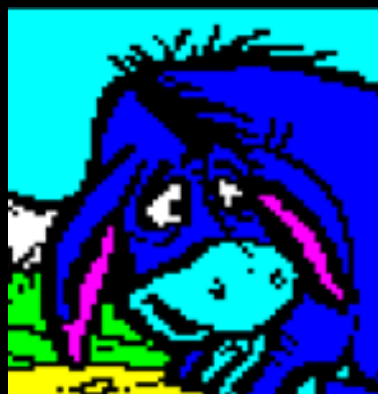
The first time I used a teletext system to produce images was with the betting shop chain Ladbrokes in around 1995, their system was slightly more advanced than traditional teletext as it was just being broadcast to their chain of stores, and as they had limited pages they could display more data. My job was to produce images relating to logos, deals and offers for various sporting events, but mainly it was making pictures of horses and footballs.

From there I went to work at Teletext, they had recently won the contract to take over from Oracle as the UK's commercial teletext provider. My best friend, known in UK gaming journalism as Mr Biffo was working there as the designer, he had recently co-created the cult gaming section called "Digitiser", this had become a smash hit and was actually the most popular section on Teletext, so this was taking all his time it gave me a foot in the door to join to take over his graphic duty (which was lucky for me as the National Lottery had just been launched and Ladbrokes cut my job as they had lost a huge amount of income).

I really enjoyed it to start with but eventually working at Teletext pretty much resulted in me swapping horses for palm trees, planes and boats for the holiday advertisers. Within 4 years I had moved on to website design and IT development and Teletext became a thing of the past for me and eventually the service was closed down in the mid 2000s.

When did you decide you wanted to create art in the format? What inspired you? Had you already been creating character-set based art elsewhere, or was this your first foray into it? Were you already artistic or did teletext bring out creativity that you hadn't experienced before?

Teletext art was never my chosen field, I loved drawing and painting, had a few commissions in the past for artwork and comic books, but even that slipped away as I had to get a proper job. But I was really lucky to fall into it Teletext, I just wish I had appreciated it more at the time. How I got back into Teletext was down to Digitiser again! In 2016, the brilliant @illartrate and



Teletext ART





The ART SCENE



@that_other_Carl created an event to celebrate all things Teletext and Digitiser called "Digifest", this brought together a whole group of ex-teletext and Ceefax employees as well as celebrity fans for a weekend of panels and shows, and if it had not been for this I'd probably not have ever got into it again.

But at the time of organising Dan and Carl didn't know who I was until Mr Biffo asked if I wanted to join him on the artists panel with him, and as I was having a rough time at work I saw it as a great opportunity for a fun weekend, so I couldn't say no. Then I started to panic as I realised I had not worked on a teletext image for almost twenty years, and I wasn't even sure I was able to do it as it had been such a long time. My other concern was I didn't know if the software or any so far existed to even do teletext work again. When I used to work for teletext the software was incredibly expensive and to use it at home you had to plug a "dongle" into the back of your PC which would act as a license, and I knew I wouldn't be able to pay for that just do teletext again.

Luckily I found out from Mr Biffo that there was a perfect Teletext editor that had been written by an amazingly talented programmer named Simon Rawles, Simon had created this from the original specification after a conversation with @illarterate. The software is called edit.TF and it is so close to what I remember, but it's freely available and runs in a web browser. The first time I opened up the blank page and started editing, it felt like I'd never been away, it'll come back naturally to me.

What inspired me to try to develop teletext graphics to an art form was the fact I was now doing it for fun and it wasn't a job anymore, no more horses and palm trees. What has amazed me is the fan following of teletext in the UK and around the world, it's so nostalgic for so many people and I think they love the colours, it makes people happy. So when I started up with creating Teletext art I decided to stick with that feeling of nostalgia and work on mainly pop culture images. As soon as I started to get feedback I realized I loved doing this as much as people loved looking at it. Over the last 18 months I've produced almost 1500 designs and I try to publish at least one new design every day on twitter (@Horsenburger)

Recently I have also been getting into the ANSI art scene, working with Blocktronics and Mistgris, which is something new for me.

What sorts of things make the best subjects for teletext art?

Complicated scenes make the worst subjects for teletext art due to the system limitations, the canvas, pixelar shape and colours can even prove a struggle for faces unless the person is very recognizable. Cartoon characters are very good unless they require much detail. This is the reason I like producing pop culture icons is because they are so recognizable, and there's the trick, if it looks like something the viewers' imagination will normally fill in the blanks, this does half the work for me. I often think what I've done isn't very good when I'm doing it, I usually only like it when I go back to it the next day, it's pretty weird.

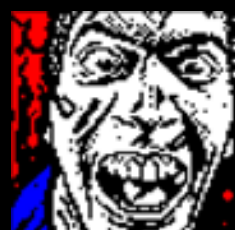
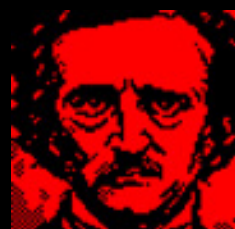
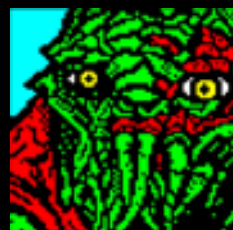
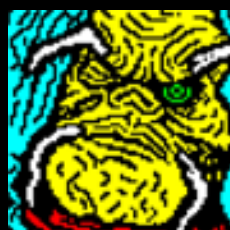
What are the idiosyncrasies of the teletext format? How do you work around them?

The biggest issues with teletext is the fact it is just 3-bit, I think each page has to be under 1kb of data so the canvas sizes is only 78 by 75 pixels and it's colour palette is limited to Blue, Cyan, Red, Yellow, Green, Magenta, White and Black. You also just use the keyboard to edit, there isn't any mouse use involved normally. Other "features" of the system include every time you change colour, size, text or graphic, you have to put down a command block which uses a block of six pixels, these can't contain pixels or text. You can use coloured backgrounds, but I choose not to as I think with bold black border around each colour, helps the design look clearer. So if you are going to have a go, my advice is keep it big and bold, try to think about it as more like sculpting pixels than drawing.

I think it is the limitation of the system which makes it so much fun for me, and I always love being challenged.

What software tools did you use for creating your first teletext screens? Has that software changed over time? What software do you use now?

Back in the day I'm sure the system we used to work on was called winsprite, and it worked on a windows 3.1 computer so was a long time ago, I now use edit.TF, that is my tool of choice, but there are at least two other free to use teletext editors out there available at the moment. These are all produced by teletext fans, and they are so good. The main reasons I use edit.TF is because it is the as close to the system I used to use when I was at teletext. The other editors also feature the system that never managed to be ready before the plug was pulled, these allow you to use level 2.5 features, which include the ability to use eight of any colour you want. But I'm old fashioned, and I just want to stick with the limitations of level 1 teletext.



Do you plan on creating more teletext art in the future? What other artistic endeavours are you involved in? Where can people find out more about your art?

I intend to keep doing it until I run out of ideas, or people stop looking at them, over the past year I've produced teletext artwork for books, youtube channels and podcasts, I have had Teletext artwork displayed in galleries and shows around the UK, it's been an amazing time. The only thing that will slow me down at the moment is my current job which is taking 14 hours a day up a call centre. I think there are still plans for another teletext block party this year and I will also be at the nova 18 demoparty in June, and in July I'll be working on the kickstarter funded Digitiser TV show - retro gaming youtube special with Mr. Biffo and a host of YouTube celebrities and guests, it's going to be a busy year.

If you want to find out more about me just look up Horsenburger online, you can find my YouTube channel where I have examples of designs being produced by myself, my Twitter feed has daily updates, I also have my Horsenburger.com website, a Red Bubble store, Fiverr page and a Patreon if you want to support me.

Thanks Steve!



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THE TOY

The light gun spawned a whole genre of "shooting" games.

The first mechanical light-gun games appeared in the arcades and midways of the 1930s. Following the invention of the light-sensing vacuum tube, companies such as Seeburg produced games that had the tube hidden inside targets, which would drop when "hit" by a beam of light emanating from a toy rifle. This included the first light-gun "duck hunt" game.

Several other electro-mechanical games appeared throughout subsequent decades, culminating in Japanese manufacturer Sega's first arcade hits, including 1966's Periscope and 1972's Killer Shark.

Following the 1972 release of the first home video-game system, the Magnavox Odyssey, and its Shooting Gallery game, mechanical light-gun arcade games began to be replaced with video-based ones. However, rather than emanating light, as in the mechanical games, the gun used in video-based games detected it.

There were three methods used. The first method, used by the Odyssey, simply detected if the rifle was pointing at a bright-enough light source when the trigger was pulled. It assumed that the player was pointing the rifle at the screen, and that the only source of light would be a target. Similar arcade games mounted the gun on a stand with fixed movement, to prevent cheating.



Photography by Tony Graham

Shootout of the Video Game Systems

Atari vs. 1

SEGA
SHOOTING GALLERY
PERISCOPE



The Magnavox Odyssey used spots of light generated on a television screen to highlight "targets" printed on a plastic transparent overlay. A simple light detection system inside the rifle registered a "hit" if the light was strong enough, and you could "win" simply by pointing the rifle at an illuminated light bulb!

The light gun for the Sega Master System was a bit more sophisticated, however. The position the gun points to on the screen is located by tracking the progress of a point of light moving through the CRT's raster scanning process.

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SAFARI-HUNT - Sega

Sega's software for use with the pistol includes three games; *Safari Hunt*, *Marksman* and *Trap Shooting*. *Safari Hunt*, as the name implies, involves shooting various animals that bound or flap around the on-screen jungle. The scenery and the animals change for each round though the graphics are generally simplistic with a rather blocky aspect to them.

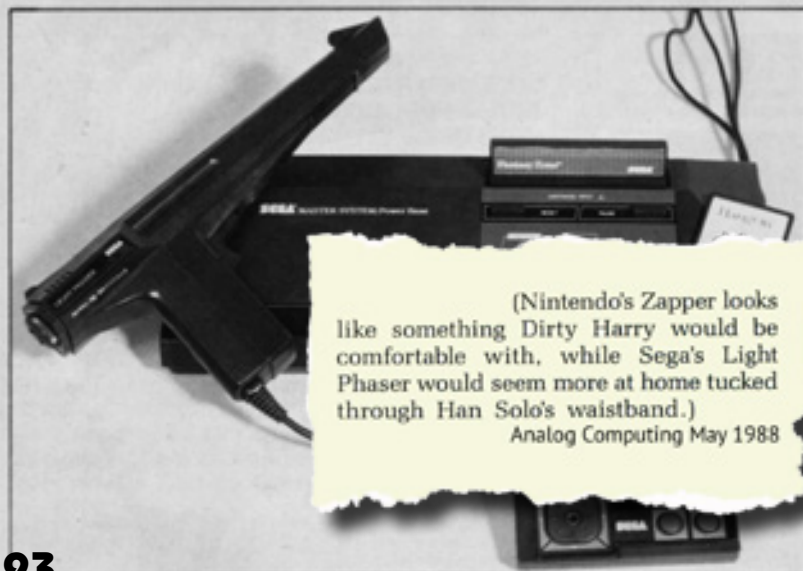
Marksman takes place on an indoor range of the type favoured by Clint Eastwood when in practice with his Magnum 44. Silhouettes of baddies pop up or trundle across the screen; waste the requisite number and you can go on to the next stage. The perspective and shading of the game are good, the sound is suitably atmospheric and the game proves to be quite a test of your marksmanship.

Trap shooting, as the Americans call clay-pigeon shooting, boasts wonderful explosions when you score a hit. This is a good shooting cartridge, let down somewhat by the far too simplistic *Safari Hunt*. Still, Sega's pistol-packing game gets nearer the bull's-eye than the Nintendo offering.

Advanced Computer Entertainment
October 1987

(Nintendo's Zapper looks like something Dirty Harry would be comfortable with, while Sega's Light Phaser would seem more at home tucked through Han Solo's waistband.)

Analog Computing May 1988



STORE

Once video targets progressed past being mere spots of light and into full-colour sprites, a second, slightly more sophisticated method was developed. When the trigger on the gun was pulled, the screen would blank, and a silhouette of each potential target on the screen would light up sequentially (or all of them at once, in poorly programmed games).

If the gun sensed light at the right time, the game assumed where it was pointing. This was the method used by Nintendo's light gun, called the Zapper. Like Sega, Nintendo had also manufactured several electro-mechanical light gun games in the late 1960s and early 1970s, including the first incarnation of Wild Gunman, a "wild west"-style dueling game in 1974. But after arcades were fully conquered by video games, the company focussed on developing joystick-controlled titles.

When Nintendo attempted to get the Nintendo Entertainment System into North American toy stores in the mid-1980s without success, it was determined that the console would be more palatable to retailers if it had "extras" that distinguished it from then-shunned consoles such as the Atari 2600, which had stung them in the 1983 video-game crash.

Two extras were eventually chosen to be launched with the console: a toy robot called R.O.B., and a light gun – the Zapper. To be as family-friendly as possible, the Zapper's companion game was Duck Hunt, an animated duck and clay-shooting game "hosted" by a humorous hunting dog that mercilessly mocked the player whenever they failed to shoot any targets (darn that dog!) Due to the simplistic nature of the light gun, most Zapper games use large, spread-out targets, such as Hogan's Alley, available for purchase separately at the NES's launch in 1985.

THE NINTENDO ENTERTAINMENT SYSTEM.



by **DUCK HUNT**
One of the extra moneyspinners for Nintendo is its Light Gun. There are a variety of games for it and I will be sampling two this month, Duck Hunt and Wild Gunman. I will be looking at the light gun game next month GUMSHOE. Duck Hunt is a simple little zapper with three play options, one duck, two ducks and Clayshooting. One Duck is simple, you are faced with a leafy green pasture and have to shoot down a rather energetic duck. The scene starts with a real cutie dog bounding into a bush and flushing out the duck for you to pop your gun at. You have three shots and limited time before the duck



THE LIGHT GUN THAT'S LOADED WITH THRILLS.

Through our breakthrough light sensing technology, we've created an exclusive light gun. The Zapper. Never before has there been a video gun of this caliber.

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But hit or miss, The Zapper is always loaded with thrills.



LIGHT GUN SERIES

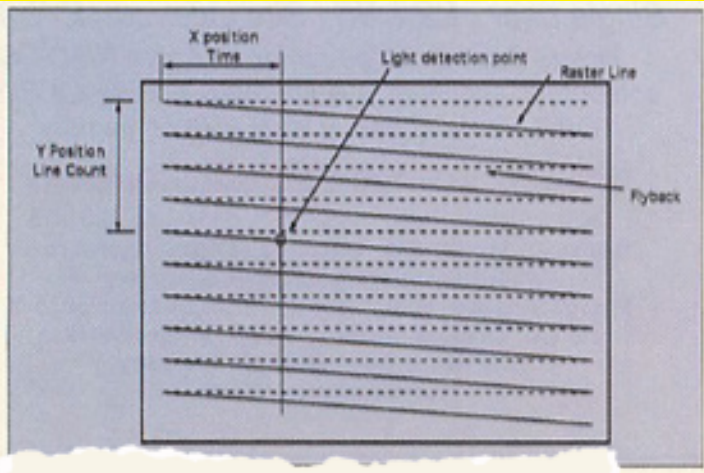
Take aim, fire and score! With Light Gun Game Packs that are light years ahead of anything you've ever played.

Duck Hunt™
Gumshoe™
Hogan's Alley™
Wild Gunman™



Due to its being packed-in with the majority of NES consoles sold (usually on the same cartridge as Super Mario Brothers) Duck Hunt can easily be declared the most-played light-gun game of all time, a favourite of tens of millions of children who grew up in the late 1980s and early 1990s. The cartoonish nature of both gun and game also pleased parents, who would've been more reluctant about allowing their youngsters to shoot at more realistic targets!

However, games involving human targets were much more popular in video arcades. 1984's Hogan's Alley was one of those – the player was tasked with shooting (video) cardboard-cutout criminals at a police-style target range while not shooting the innocent bystanders. Nintendo allowed a version of the game to be produced for the NES's launch in 1985 because the targets weren't "real".



The diagram to the left demonstrates the pattern the electron gun in a cathode-ray tube (CRT) display follows as it sweeps down the screen. Sophisticated light guns measure the time it takes for the electron gun to get from the top-left corner of the screen to the light gun's target location.



Let's start off with a little reminder about what we are trying to do. A TV or monitor works by directing a bright spot to perform a zig-zag scan across the screen from top to bottom as shown in Figure 1. The computer keeps track of this spot by issuing pulses, one tells the spot to start off at the top (the frame sync) the other tells it to start a left to right sweep – the line-sync pulse. If we have something to detect the light as the spot whizzes past we can work out the position of the light detector from the timing of the pulse it gives.

The Y coordinate can be found by counting how many line-sync pulses there have been since the last frame-sync pulse. The X coordinate is a bit more complex, to find that we have to time how much time has passed since the last line-sync pulse. By knowing how long the spot takes to move over the length of a whole line we can find the fraction of how far across the screen the detector is placed. This is complicated by the fact that different monitor standards use different amounts of time to complete this journey.

Acorn User April 1999

Sega was not to be outdone. With the launch of the Sega Master System the following year, in 1986 it also introduced a light gun it called the Light Phaser. A companion cartridge was also released; called Safari Hunt in European and other markets, players shot at fixed, clay and animal targets, but in North America the animal portion was removed out of concern parents would object to the shooting of mammals such as bears, and it was more plainly titled Marksman Shooting & Trap Shooting – a real mouthful!

However, because Sega was still in the arcade light-gun game business, it wanted their light gun to be more flexible than Nintendo's, and so it used a third method. Rather than detecting if a particular object is correctly targeted when the trigger is pulled by blanking the screen and "lighting up" the targets, the Light Phaser worked more like a computer light pen. Popular on graphical computer terminals in the 1960s, light pens were used for selecting objects and text and drawing on the screen. They worked by exploiting the mechanics of a cathode-ray tube display.

To draw a frame of video, the electron gun scans across and down the CRT display, following the "raster" pattern (see top-left). Phosphors on the under-surface of the front of the CRT are energised and release light. This creates a very fast-moving "spot" – it moves so fast, in fact, that our mind sees the entire frame appear instantaneously.

When the spot gets to a light pen's position, the newly re-energised phosphors are detected, and the computer works out its location based on the number of

horizontal sync pulses that have occurred since the start of the frame, and the time since the last pulse. This method is fairly accurate, and in a light-gun context allows for "live" graphical feedback of the target location using iconography such as cross-hairs, for example.

However, the Sega Master System seemingly only calculated the location when the Light Phaser's trigger was pulled.

During the last quarter of the 20th century a number of light-gun controllers were produced both for consoles such as the Super Nintendo, Sega Mega-drive and Sony Playstation, and computers such as the Sinclair Spectrum 128K, Amstrad CPC and the Commodore 64.



paleotronic

Magnum gets go ahead to make Amstrad's day

Amstrad and Virgin/Mastertronic have announced that a light gun package, called the Magnum, is to appear soon. Initially it is aimed (if you'll pardon the pun) primarily at

the gun, which is expected to retail at £29.99. Five have been finished, and Virgin/Mastertronic are currently trying to get more

coming. The deal is now well underway. We've got a working proto-

type, and have been testing all the games on it. Amstrad are looking up to start full scale manufacture in the coming months; people should be able to buy a Magnum

Beaten to the draw

The news of the Magnum lightgun is a shot in the arm (excuse the pun again) for the CPC games market as it moves towards the traditional very busy dog-days of summer. It's not such a reason for celebration, though, at Electric Studio Limited.

As reported exclusively in A&E, Dave Buckingham had already come up with the idea for a light gun, and had in fact produced a working prototype. The news news of a deal between such big players as Virgin/Mastertronic and Amstrad themselves is enough to scupper his plans.

Our problem was getting games written for it – nobody seemed interested, a crestfallen Buckingham told us. The project has now been shelved. It was always going to be a risk, something to try – but not with Amstrad competing against us. All our products are built in the UK, but with Amstrad's Far Eastern production lines and sheer muscle power we haven't got a cut in help's chance. Perhaps if we'd got it out quicker, we might have had a winner. But not now.

game play-ers, though it has great potential in other areas too. Amstrad are to manufacture the gun – which is similar to, but not identical with, the Sega light gun – under the Amstrad/Fidelity label, while Mastertronic are to market exclusively. The games are included with

written for the device. Melanie Russell, speaking for Amstrad, was happy to confirm the deal, in spite of Amstrad's former record of reticence about products not yet available in the shops. 'We're all true,' she said, 'though the only thing that is concrete is the deal itself. Both Amstrad and Virgin/Mastertronic have signed on the dotted line, but the Magnum is not yet in production.'

For Virgin/Mastertronic Lesley Walker was slightly more forth-

• Above: the Magnum's starting point



Nintendo light gun is more accurate—if something is lined up in its sights, that's exactly what you hit. Not so with the XG-1. You'll find that it often shoots to the left or right, depending on the software you're running.

The XG-1 is simply a specialized light pen. Light pen support was built into the earliest Atari computers, but it never really caught on. In the shape of a gun, the light pen has brought a whole new dimension to video games applications. The light pen horizontal position, LPENH, can be PEEKed at memory location 564, and the vertical position, LPENV, is found at location 565.

Light gun values range from 0 to 227. You will notice that your horizontal readings are quite odd. Try the sample program below, and notice how the GUN-X readings vary as you sweep the gun across the screen, left to right.

```
10 LPENH=564
20 LPENV=565
30 GRAPHICS 0:POKE 752,1:POKE 712,15
40 POS. 0,0:FOR I=1 TO 4:"0123456789":NEXT I
50 ? "GUN-X=";PEEK(LPENH);" "
60 ? "GUN-Y=";PEEK(LPENV);" "
70 ? "TRIGR=";STICK(0)
80 GOTO 50
```

Antic August 1988



BARNYARD BLASTER

Barnyard Blaster's background graphics are colorful and the target animation is excellent. Inanimate objects explode convincingly, while the animals disappear in a tasteful twinkle. Each of the three scenarios has an introductory screen that you can blast realistic holes into.

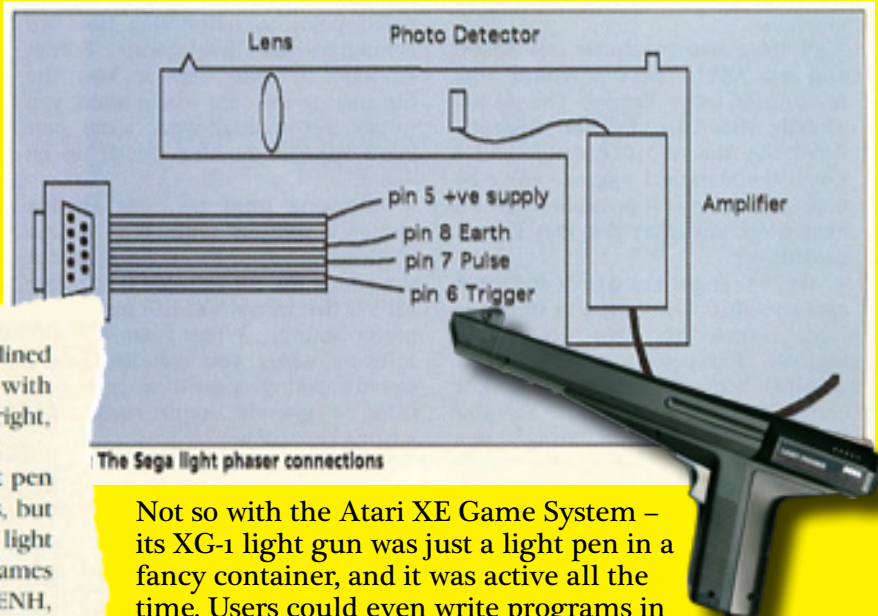
You simultaneously blast away at stationary objects—pumpkins, bottles, watermelons—and moving targets—gophers, mice, chickens. Ammunition is limited and there's a bonus round where you shoot bottles thrown into the air by "Gramps." Sometimes a blank rectangle or garbage appears on the screen instead of the score, but this doesn't seem to affect the game.

Antic June 1988

Barnyard Blaster was one of the few games produced for the XG-1 light gun, but it was rushed, and its graphics were uninspiring.



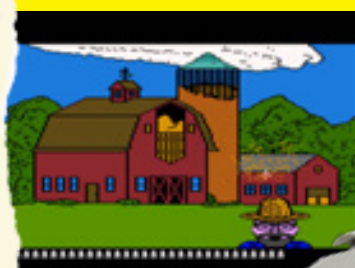
Not even a light gun could save the doomed XE Game System, a "Hail Mary" thrown by Atari that the market refused to catch.



The Sega light phaser connections

Not so with the Atari XE Game System – its XG-1 light gun was just a light pen in a fancy container, and it was active all the time. Users could even write programs in BASIC that detected the target location of the XG-1! Unfortunately, however, the XEGS came toward the end of Atari Corporation's existence, and very few games were produced that supported the XG-1, its potential largely left unexploited.

Sadly, with the end of the CRT era also came the end of the usefulness of most light guns, as LCD and LED displays work too differently for any but the simplest methods of light-gun detection to function with any accuracy. Instead, pointing devices like the Wiimote use sensors placed around the screen.



The XEGS was just a repackaged Atari 65XE, itself a repackaged 800XL. Luckily, it was compatible with all Atari 8-bit software.



SHOOTOUT! 2nd-generation videogame machines

Atari XE Game System
vs. Nintendo & Sega

Online with
Genie

5 EASY-TO-TYPE
PROGRAMS

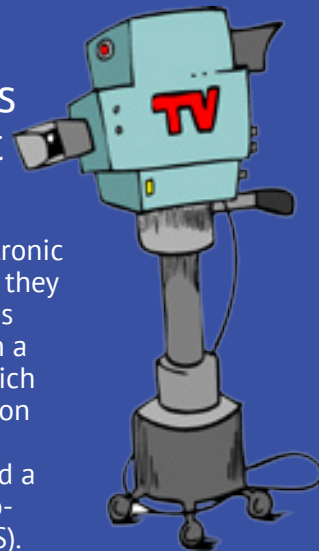
8-BIT

- Graphic Adventure
Creator
- Videotape Text
Designer
- Deluxe Smooth
Scroller

ST

- Random Maze
Builder
- Time
Review

While the age of television meant you could electronically capture a moving image and broadcast it to receivers “live”, there quickly became an obvious need to store that moving image either for posterity or use at a later date.



In the early days of television, there were no electronic means by which to record programs, which meant they had to be filmed, either with separate film cameras co-existing on set with television cameras, or with a kinescope (known in Britain as a telerecorder), which was in effect a movie camera pointed at a television screen. A kinescope film could then be broadcast later by using a telecine process, which either used a variation of Baird's flying-spot scanner (UK) or projected a film directly on to an Iconoscope tube (US).



To ensure that television programs aired on both the east coast of the United States and the west coast at the same local time, television networks would air the program live on the east coast, transmit it via a series of long-distance coaxial cables and microwave relays, kinescope it, then telecine it when it was time for the west coast broadcast. Once this process had finished, the film stock was frequently disposed of in the belief that keeping it served no purpose, and despite being recorded programs were often still lost.

Obviously this was not ideal and videotape was meant to solve many of those problems. Attempts made at videotape recording (VTR) in the early 1950s recorded video in a similar way to audio tape, but this was inefficient and used considerable amounts of magnetic tape moving at high speed (9.1m or 360 inches per second!) You could lower the speed, but it severely sacrificed quality.

This was no better than the kinescope / telecine combination, and television broadcasters rejected VTR as a replacement. For it to be viable, a new way had to be found to record an electronic video signal on tape.

Originally a manufacturer of electric motors, American company Ampex developed reel-to-reel audio tape recorders based on German designs after the end of World War II. Tired of performing two identical live radio broadcasts per night, singer Bing Crosby financed the recorders' production, which revolutionised the radio industry.

In the early 1950s Ampex turned its focus to video, demonstrating the first practical VTR in 1956, the Ampex Quadruplex. Rather than recording video linearly, like a tape recorder, it instead had four heads that rotated transversely – across the 2 inch (5cm) width of the tape, creating a series of stripes along its length. They also switched to using frequency modulation (FM) instead of the amplitude modulation (AM) employed for video broadcast. Both advances meant that much less tape was used with superior quality over previous attempts.



The Archivist



The new VTR machines, while expensive (US\$45,000 or US\$405,000 in 2018) allowed the networks to finally dispose of the awkward kinescope / telecine process, and adoption was not long in coming. However, from a preservation perspective, the situation became markedly worse! Not only was the equipment costly, but the tape it used was hideously priced – US\$300 for a one hour reel (US\$3000 in 2018!)

But unlike film, the tapes could be re-used and, while kinescoped programs had to risk being thrown away (they at least had a slim chance of maintaining survival in a dusty corner of an archive room), Quadruplex programs were regularly terminated on sight, erased from history almost without exception.

As prices on videotape came down, more programs would be preserved, but episodes from many late 1950s, 1960s and even some 1970s TV shows were lost forever.



Doctor Who: The Lost Episodes

One high-profile victim of videotape recycling was the British science-fiction drama Doctor Who. The BBC never imagined that there would be any enduring interest in the show, seen at the time as a silly children's program whose value was merely to fill time in the broadcast schedule. Tapes were routinely wiped and by 1978, when the BBC put an end to the destruction, approximately 178 episodes were missing.

However, the emerging home video sector of the late 1970s combined with the deep pockets of nostalgic, now-grown former Doctor Who viewers, provided an incentive for the BBC to make an effort to recover the missing episodes.

Recovery

Luckily, many of the missing episodes had been sold to overseas broadcasters, shipped to them on telerecorded 16mm film stock. The BBC asked these broadcasters to check their archives, and episodes were discovered and returned from countries such as Australia, New Zealand, Canada, Nigeria and the United Arab Emirates. Other films, originally sent overseas but since purchased by UK-based collectors, were also returned. In total, 81 episodes have been returned since the effort began.

Restoration

Telerecorded films are not interlaced, and consequently have a different "look" than videotaped broadcasts – while overseas viewers experienced Doctor Who that way, UK viewers did not, and the BBC needed to use a computer to interpolate the missing half-frames. Also, some returned films were black and white; colour was restored mainly from NTSC VHS sources obtained from those who videotaped the Canadian broadcasts.

Reconstruction

Despite the repatriation of those films, many serials are still missing episodes. However, audio for these episodes exist, recorded by fans when originally broadcast. This has led to creative efforts to reconstruct the video, including animation, such as in The Power of the Daleks (1966, re-released in 2016 as part of the 50th anniversary celebrations of Doctor Who's first airing).



The video of the second Doctor's (Patrick Troughton's) first serial The Power of the Daleks was wholly lost, and unrecoverable since rights arguments over ownership of the Daleks had prevented wide overseas distribution. However, its audio existed, and so in 2016 the BBC animated the entire serial.



CRT Trouble?

Danger Will Robinson HIGH VOLTAGE!



In order to work, a TV or monitor uses high-voltage currents which can electrocute you!

For electrons to be attracted enough to the anode to leave the cathode in a CRT, a very high level of charge, or voltage, needs to be generated. This voltage is created by a component called a "flyback transformer", which can generate between 20,000 and 50,000 volts!

This voltage can linger for days or even weeks in both the CRT and the flyback transformer after the TV is turned off and unplugged. You don't even need to fully touch them or be grounded to get electrocuted by either! Very dangerous.

"Implode? Well, that doesn't sound so bad! Doesn't that mean it just collapses and winks out of existence? That's what it means in science-fiction cartoons anyway..."



Also, while the exterior screen surface is reinforced, the CRT is very fragile and can implode!

Um, no. The CRT is a vacuum tube – it has no air in it, because any matter (molecules, atoms, etc.) would interfere with the electron stream. But the air around it wants in, to equalise the pressure, and if the smallest hole or crack is made in the CRT, the outside air will push in on it, crushing it.

IMPLOSION!

But once all the glass piles into the centre, it's not like it just stops there. All that kinetic energy has to go somewhere, and no longer confined by the equalising air pressure, all those glass fragments then just go...well, everywhere, like shrapnel from a hand grenade!

More modern CRTs have "implosion protection" which is meant to reduce the risk of the tube crushing, but it's not 100% effective. So do you really want to take that chance?

Both high voltage and implosion risks should make you want to be very careful around CRTs!



Collector's Corner

“So what exactly can I do to try to fix a broken CRT TV or computer monitor?”

Well, firstly don't bother acquiring a non-working CRT if a working one is available. But here's some tips on how to tell how much trouble it will be to fix...



1. It doesn't turn on or there's no screen.

Does anything happen? Does it have a pilot light that comes on when you plug it in? If it does, then does that light change colour when you press the power button? Does it have a remote? Have you tried the power button on the remote?

Sometimes a defective power switch or disconnected control panel can prevent a TV or monitor from turning “on”. Also listen for a “zap” when you press the power switch. If you hear that, but the CRT doesn't brighten up, you could have a bad flyback transformer. These are typically straightforward repairs (when done by a professional!) Would be worth looking into.

2. There's no colour, or the screen is “rolling”.

Have you adjusted the colour / vertical hold (vhold) controls? (Sometimes they're hidden under a panel on the bottom or side of the monitor or TV, or may be inside an on-screen menu somewhere) Do the on-screen menus have colour? Do they roll? Have you tried another signal source, e.g. another console or computer?

Don't forget that NTSC and PAL signals are incompatible – so if you use a PAL console on an NTSC TV, there won't be colour and it (might) roll, and vice versa. Also, some computer monitors used in PAL countries are actually NTSC (for example Apple composite monitors). If you find mechanical controls and there's still no colour or you can't stabilise the picture, it could be a bad control which might be fixed using contact cleaner, but otherwise it could be a serious problem with the video decoding circuitry which could be very time consuming (and expensive) to fix. Pass.

3. Picture is dim, blurry or too bright.

Once again, check for mechanical or “soft” brightness / contrast controls and adjust them. If you see flickering on the screen when you adjust mechanical controls, they could need cleaning. Give it a minute or two and see if the picture improves.

CRTs do have a finite lifespan and a dim picture could be a sign its time is almost up. Pre-1994 CRTs can often be “rejuvenated” with special equipment, but this may only improve the picture for a short amount of time. There are other methods to brighten up (very) old TVs, but they are a gamble.

Focus can be adjusted (by a technician via an internal control) to sharpen up a blurry image – but not if the voltage has been increased to overcome a dim CRT! Check if there's “bloom” (the picture looks like it's ballooning out to the edges) – if so, pass.

Other issues can include “rainbow” fringes on the edges of colours (can often be adjusted on older pre-1990 CRTs) and areas of weird colour or brightness (can usually be fixed by “degaussing” or demagnetising the CRT.) More complex issues are typically expensive to repair. Caveat emptor! 🌀

cpt kangarooski
Ars Praefectus

Registered: Mar 25, 2001
Posts: 3139

Posted: Wed Dec 03, 2003 9:08 pm

I think the bottom line is that if you mess around inside a TV you run the risk of the TV killing not only you, but also brutally killing your friends and family just to send a message to others.

EMULATING STRETCHING



Colour CRTs work by having three electron guns, each of which strike phosphors that emit red, green or blue light respectively. This combination of phosphors appears over and over again in a scanline, and our mind combines the brightness of each of these to mix them into a distinct fourth colour.

While LCD and LED displays also use groups of colours to form pixels, these pixels are much smaller, and thus when classic video games are viewed on an LCD or LED monitor or TV, the colours may seem strange or wrong to some players accustomed to the CRT image.

Finally, prior to the era of “flat-screen” CRT displays, video game graphics tended to “balloon” out from the centre, following the curved edges of the tube and creating noticeable distortion in straight lines and rectangular shapes.



For some nostalgics it’s not merely enough to emulate the console or computer – they want to emulate the CRT they used it on too!

The nature of cathode-ray tube displays distinctly affected how images are presented by them. For example, its electron gun(s, three inside colour CRTs) sweep from left to right, illuminating one horizontal line and then another underneath. Each line is known as a “scan line”, and a distinct dark gap is formed between them.

These gaps form what looks like a grill over the image. Furthermore, because the phosphors in each scan line are actually struck by the electron guns progressively at a descending angle from the left side of the screen to the right, moiré patterns – visible interference such as ripples or waves – can appear, especially with dithered or half-toned graphics.



Street Fighter 2, a favourite of 7-Elevens everywhere...

All of these effects combine in varying degrees to create the “stereotypical” CRT image - although the final product depended heavily on the model of CRT and how it was calibrated. Some had more distinctive scan lines, others had more ballooning; some used one method of arranging red, green and blue phosphors, others another.

Ultimately, it depended on what brand and model of TV you plugged your console into, or what picture tube they put into the cabinet at the arcade. Therefore, many emulators provide controls to allow users to add and adjust some or all of these effects to their users’ individual tastes.

CRT SHADERS



A “shader” is an intermediate computer program (usually executed by an additional, specialised CPU that is part of modern video hardware called a GPU) that processes video output from a primary program (for example a video game) typically to add visual effects.

“CRT shaders” are a class of shaders which emulate CRT-based displays. There are several of them, with names such as CRT-Geom, CRT-Lottes and CRT-Royale.

Each one has varying options, but most at a minimum emulate the effects of scan-lining on “aperture grille”-style (one method of ensuring accurate phosphor activation by individual red, green and blue electron guns) CRT displays – the most popular type of CRT emulation due to the crispness of the scan lines it creates.



Others can emulate screen curvature, defocussing, colour convergence (or more accurately the lack thereof) and more, although configuring them correctly can prove to be a complex endeavour. It all depends on if you’re motivated enough to expend the effort required to replicate the old Sony TV you (or your Dad) had in your (their) room as a child, or not. 📺

Variations in the personal experiences of vintage video-game players and computer users highlight the impact the quirky natures of cathode-ray tube-based televisions and monitors had on those experiences. CRT emulation allows some to replicate those experiences, while others can experience them for the first time.

RetroArch and Libretro is a popular combination of emulation software that supports most available CRT shaders.

Libretro isn’t a single piece of software, but a series of software “libraries” that emulate various consoles, such as the Nintendo NES, Super Nintendo, Atari 2600, and Sony Playstation; and computer systems such as the Atari ST and Commodore Amiga.

These libraries have a common API, or application interface, which allows for the creation of customised, detached front-end software such as RetroArch.

RetroArch and Libretro are available for Windows, macOS and Android, and can be downloaded from libretro.com



EMULATING
THE TUBE

april-june 2018

New Hughes Tomotron Tube for the space age



Space-age tube of electron storage for the space age, the Tomotron tube.

Now you can get clear, instant image displays of slow scan TV transmissions from space vehicles, satellites, or earth-orbiting sub-orbits. The new Hughes multi-mode Tomotron® storage tube, the most advanced display device on the market, makes this possible. In addition to the excellent clarity that was only available from Tomotron tubes—excellent persistence and high brightness—these new multi-mode tubes offer the ability to selectively erase target information, present images in various displays, and produce high-resolution light or dark trace patterns. Images.

The Hughes multi-mode Tomotron tube can have your display and more. Write or even call for full information.

For more information, write Hughes Electronics, 20000 E. 1st Ave., Denver, CO 80231.

Tomotron is a registered trademark.

HUGHES

20000 E. 1st Ave., Denver, CO 80231



NASA sent slow-scan television images from the Luna 3 spacecraft of the far side of the Moon in 1959, and subsequently used a 320-line system for transmitting images from various Apollo mission space capsules as well as the Apollo 11 lunar module. SSTV was also used in the Russian space program.

You are about to enter the wonderful world of amateur slow scan television. Imagine yourself sitting in front of a radio receiver with a slow scan television monitor plugged into the headphone jack. The screen shows SMØBUO in Stockholm operating his rig from his lakeside cabin. You turn your dial to another frequency on the 20 meter band and observe WØLMD exchanging circuit diagrams with W4TB in North Carolina. These things are now possible with slow scan television. It has not always been this way, so let us turn the slow scan history pages back a few years to see how it all began. 73 MAGAZINE

73 magazine was an American amateur radio magazine published from 1960 to 2003. It was known for its strong emphasis on technical articles. 73 is morse-code shorthand for "best regards" in amateur radio lingo.

Given the right conditions, amateur radio operators can talk to anyone, anywhere in the world. But what about television? Could that be sent around the world too?

Analog television transmitted a lot of information, and because of its large bandwidth requirements needed to broadcast at frequencies in the Very High Frequency and Ultra High Frequency bands – which meant its signals couldn't travel very far. Once they passed the horizon, they just traveled off into space!

But amateur radio operators of the 1950s were able to talk all over the world using the 10-metre short-wave (or High Frequency) band. Unlike VHF and UHF, signals broadcast in this band can refract off of the ionosphere, a layer of the atmosphere ionised, or charged, by solar radiation. Radio operators could (and still can) "bounce" their signals off of the ionosphere, sending them back down to receiving stations far beyond the horizon, even on the other sides of oceans or in other hemispheres.

So, the question became: If we can send audio such long distances, can we send video there, too?

Well, in 1958 Copthorne Macdonald, a young engineering student at the University of Kentucky, asked that very question, and embarked on a mission to answer it. He soon realised that, fundamentally, he had to reduce the amount of the video information to be transmitted, so that it would fit in the reduced bandwidth offered by the lower-frequency 10-metre band.

A 3Mhz TV signal needed to be reduced to just 3Khz, 1/1000th of its original bandwidth!

Copthorne devised a method of encoding luminance information using amplitude modulation, varying the strength of a single tone to represent the changes in the brightness of each television scan line.

However, he could only test his scheme on the 11-metre band, which at the time was the only amateur radio band licensed by the US FCC (Federal Communications Commission) for television use. But while Copthorne was conducting his tests, the FCC reallocated the 11-metre band to citizen's band (CB) radio – and didn't designate any other amateur radio bands for television use!

Legally, Copthorne's "slow scan" television could only be broadcast in the VHF frequency band – which severely limited the range and defeated the purpose. He lobbied the FCC for special dispensation to continue test broadcasts on the 10-metre band, which he was granted in a limited capacity. During this time, he successfully sent still images across the Atlantic.

Other amateur radio enthusiasts began to notice and experiment with SSTV, exchanging audio tapes of images because they weren't allowed to transmit them on the 10-metre band, and none of them lived close enough to receive on VHF frequencies.

Meanwhile, in 1961 a new system was devised, which used frequency modulation (FM) instead of AM.

Excitement in the amateur radio community grew over the possibilities of slow-scan television, and petition after petition was written and filed with the FCC to permit SSTV broadcast on the 10-metre band. The petitions were ignored, possibly due to pressure from commercial interests which felt threatened by the idea of “free” image transmission.

However, over the next few years, several Washington-area “hams” continued to mercilessly pester the commission, which eventually broke its silence and stated a willingness to consider the issue of SSTV – if the hams proved it wouldn’t interfere significantly with normal audio broadcasts.

In 1966, tests were conducted during a three-day amateur radio convention in Colorado, and no protests from other operators were noted. Copthorne convinced the FCC to authorise further tests on the HF bands, and during the testing period the US Navy used SSTV to transmit video to and from McMurdo Station in Antarctica, with equipment provided by Copthorne. Fifteen US hams sent and received images with McMurdo, with varying degrees of reliability due to atmospheric conditions.

In 1967 the FCC published a request for comment (RFC) on a proposed rule change permitting SSTV on HF bands, and in the summer of 1968 it was approved, and licensed amateur radio operators could begin slow-scan TV broadcasts.

SSTV transmits a 120-line image every eight seconds, which uses 900Hz (cycles-per-second) of bandwidth. It is transmitted using frequency modulation (FM) on a “subcarrier”, or a representation of a lower-frequency contained inside of a higher one.

In the case of SSTV, there is an audible subcarrier which ranges from 1500hz (pure black) to 2300hz (pure white), representing the luminosity of the video signal. There is a sync pulse at 1200Hz, with two different lengths – a shorter one to represent horizontal sync, and a longer one for vertical sync.

This signal is generated and then sent to a ham radio set, and broadcast as if it were audio. It sounds like a warbling bird with a persistent ticking of the sync pulses behind it. A receiver routes the incoming signal through equipment that translates it back into a video image that can be displayed on a cathode-ray tube (in the early days an oscilloscope tube) or, in modern times, on a computer.



Fig. 1-1. Picture of W9CNW, sent from VK3AHR, 10,000 miles, on 2.5 MHz bandwidth.

Image broadcast 16,000km from the US to Australia in 1966.

Various video cameras have been used to generate images, but another method, using transparent photo negatives or positives taped to the front of a television screen, its brightness turned all the way up, hearkens back to Baird’s flying-spot scanner. A photocell is used to measure the light emitted from the TV’s raster passing behind the image, which is then encoded and broadcast.

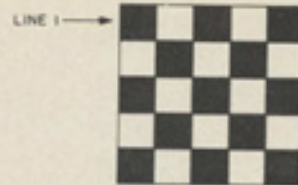


Fig. 1-4. Checkerboard pattern for slow scan transmission. The video signal and sync signals are shown in Fig. 1-5.

As a visual example of pattern generation, consider the following black and white SSTV transmission (shown in Fig. 1-4).

The video and sync signals are shown in Fig. 1-5.

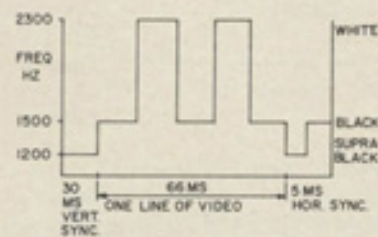


Fig. 1-5. One line of composite sync and base video.

The diagram above demonstrates how a slow-scan television signal is encoded. In this case, a checkerboard is represented by pulses of two different frequencies, one representing pure black, and the other representing pure white. A synchronisation tone (marked “supra black”) demarcates separate lines.

While an amateur radio operator could (and was encourage to) build their own SSTV equipment, several vendors offered preconstructed commercial products, such as the one in the advertisement below.

SCAN-VISION

SCAN-VISION

Now—unmatched picture performance with exclusive feature equipment of highest quality in which the most advanced SSTV techniques are expertly applied—SBE Scanvision. Here, carefully considered design has simplified operation to the point where the non-engineer radio amateur can have his SBE Scanvision monitor connected and start enjoying slow scan in just a matter of minutes.

Most of the many hundreds of SS TV's now active on the air agree that the full excitement and enjoyment of SSTV can best be realized only when a tape recorder is part of the system. Incoming pics are taped for future viewing on SS monitor—pre-taped pictures, scenes, info—can be transmitted. So—excellent—every SBE Scanvision monitor has a cassette-type tape recorder built-in—ready to go and operate with panel switch. Here is the ultimate in convenience.

SBE Scanvision is conservative—reliable, with proven-proved circuitry and is all solid-state except for the scope tube in the monitor and the vidicon picture pickup tube, heart of the SBE-ICTV camera. Both tubes are standard types with predictable characteristics—not surprises.

High quality is everywhere evident—throughout, the well-expected SBE approach—built-in—professional. The SBE Scanvision, SB-1MTV Monitor, complete with cassette recorder and SB-1CTV Camera with 4113. Stereo tone, connect with patch cable to complete a system. Units are also separately available.

SEE SCANVISION AT YOUR SBE DEALER

Fully meets all standards. Compatible.

Excellent built-in cassette-type recorder. Ready. Instantly.

Available—cameras with high quality elements for “hot” or “cold” pics.

Camera is equipped with quality 4113. 4113 min. temp. but extra charge.

Monitor can be used as a phone for remote-up. May report for transport.

“Live” SSTV pic photos—grabbed from monitor. Un-released.

UNIVERSAL SYSTEMS, INC.
100 Airport Blvd.
Beverly Hills, CA 90212

HAMateur Hour

HEAVY DUTY ELECTRONICS AT WORK

WAR

**Airborne surprises
can be devastating.**

As the 1920s turned into the 1930s and the decade wore on, aircraft were gradually flying faster, higher and with heavier payload capacities – the dangers that presented did not go unrecognised.

A means of detecting aircraft – specifically, hostile aircraft – would need to be developed otherwise any nation with air supremacy over another could easily conquer it.

**Germany was beginning to
make its neighbours nervous.**

In the late 19th century, scientists conducted experiments which showed that radio waves could be reflected by solid objects. A Russian, Alexander Popov, attempting to communicate between two ships by radio in the Baltic Sea in 1897, noted that a third ship passing between them created a striking interference pattern in the signal. However, he did not pursue his discovery.

In 1904 a German inventor, Christian Hülsmeyer, demonstrated a rudimentary radar system he had constructed to the German Navy, which could be used to detect a ship in dense fog – but it was rejected! Hülsmeyer's invention fell so far into obscurity that two US Navy researchers coincidentally replicated it in 1922 – only to have their not-so-inventive "invention" rejected by their bosses.

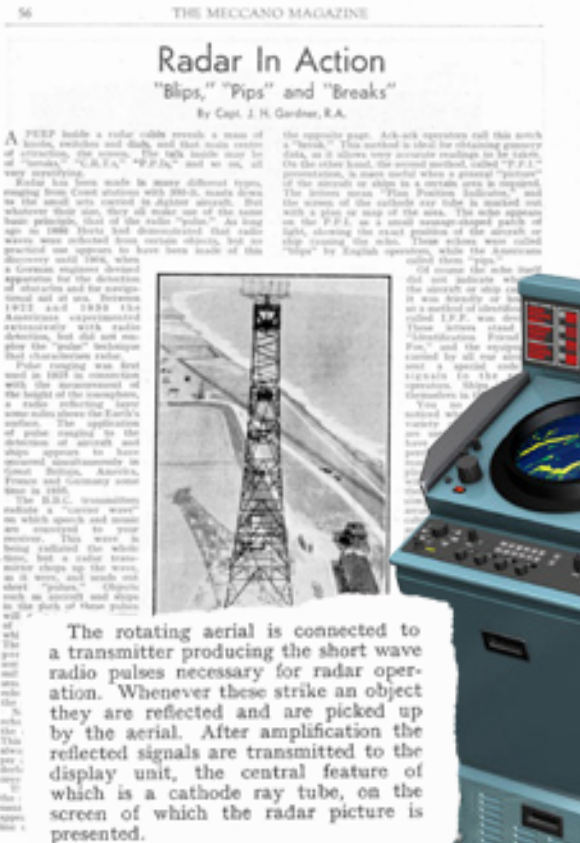
RADAR: RADio Detection / Direction And Ranging

Radar uses radio waves to determine the range, angle or velocity of objects. It can be used to detect almost anything!

Tracking the Pulse.

Working at the US Naval Research Laboratory in 1934, American Robert Page demonstrated a pulse-based radar system. Rather than transmitting a widespread continuous signal and then searching the area for reflections, Page's system transmitted a pulse focused by an antenna in a particular, fixed direction, or vector.

Another antenna then received any reflected radio waves. By analyzing the differences in the signals received by the antenna after each pulse, objects could be detected and their movement determined much more easily than had been with a continuous signal.



**Radar was not off
to a great start.**

A US Navy radar console

But as the monster of Nazi Germany began to rise and war seemed inevitable, other countries searched for any possible defenses they could find. Researchers in the US, UK, France, Italy, Japan, the Soviet Union – and, of course, Germany – worked furiously and in secret to perfect a way of detecting aircraft, in hopes of repelling their enemies or mitigating the damage they caused.

In the mid-1930s, both the French and the Soviets successfully developed functional radar systems, but they used a "continuous" mode of operation that blanketed an area in radio waves and was less successful in detecting and tracking objects than its successor.

Combined with radar,
long range surface
cannons can be
lethal to encroaching
ships and aircraft.

Meanwhile, in the UK...

The British were keenly aware of the German threat, and under the direction of Robert Watson-Watt, a meteorologist who had used radio waves to map thunderstorm activity earlier in the 20th century, they developed a pulse-based radar system they called RDF (Radio Direction and Finding).

In 1935 it was practical enough that it was proposed a network of RDF stations was built along the UK's east coast. Two years later, arrays of height-detecting antennas were added to the design, and the system went into production.

By the time war broke out in 1939, there were 21 operational "Chain Home" stations, and the entire east coast had coverage by 1940, when the Battle of Britain occurred.

The Chain Home network was critical for early-warning systems and is credited with saving many lives.



You can't see it if you don't see it.

But while the radio technology provided the information needed to determine where the enemy's planes were, analysing the returning signals was time consuming – and time was of the essence. It was realised early on that an obvious and instantaneous visual indicator of detected objects was an absolute necessity.

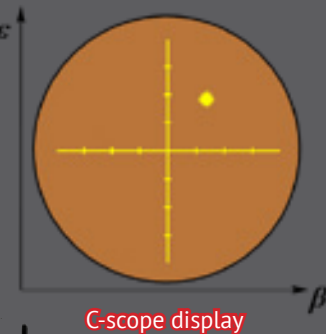
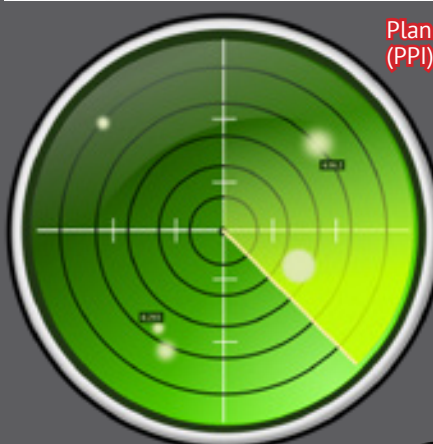
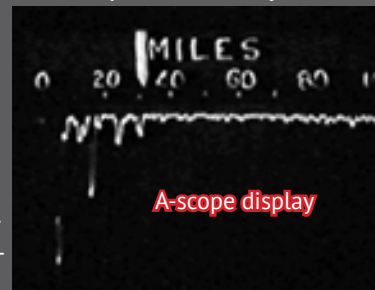
The cathode-ray tube was looked to as a preferred way to render the signals.

Each station in the Chain Home network could only sense the distance, not the bearing of a target (although reports from multiple stations could determine that, through a form of triangulation.) As such, they used oscilloscope-based displays which showed an RDF operator a waveform, with downward disturbances in it indicating the location of targets. These were known as "A-scope" displays.

B-scopes provided top-down representations of the signals provided by airborne radars, which swept from side to side. These showed a "slice" of airspace usually following the plane's heading.

The C-scope provided a "bullseye" view of direction and elevation. The blip showed the location of the target relative to the aircraft (or gun) the radar was attached to. This is a common indicator used for targeting in air battle-style video games, and it often flashes when the target is in the "crosshairs".

Finally, the plan position indicator (PPI) displays the area "swept" by a rotating radar antenna, with the radar's position at the centre. This shows both distance and direction.





Direction Finder

Cathode-ray beam course indicator developed for aircraft use

AFTER many years of supplying radio direction finding equipment to the merchant marine and the government, the Airplane & Marine Direction Finder Corporation (Lindenhurst, L. I., N. Y.) is offering for commercial aircraft use an aural-null and right and left visual indicating direction finder using a cathode-ray beam instead of the conventional needle in the indicator.

The Other RDF...

Radio detection finding (RDF – not to be mistaken with the British radar system) dates back to 1888, when German physicist Heinrich Hertz discovered that an open loop of wire used as an antenna could establish the direction of a transmitter. When the loop was pointed toward the transmitter, the signal received was at full strength, while if the loop was perpendicular the strength would drop to nothing.

By mechanically rotating the antenna, an RDF operator could determine the location of a transmitter. However, in order for the beacon's signal to propagate a long distance away, it broadcast using long-wave frequencies. Since the loop needed to be typically half the "length" of the wave, it could be several metres in size!

This made mechanical rotation difficult – the US Navy worked around the problem by sailing its ships in circles instead! This solution was obviously not optimal, but luckily in 1909 Ettore Bellini and Alessandro Rossi developed a system that used two fixed large antennas to detect and then re-create the "radio field" inside of a smaller area, within which a directional antenna was then placed and used to establish the direction of the broader signal. This ingenious solution led RDF to see larger adoption amongst both military and merchant marine vessels, and was in common use from the 1920s to the 1950s.

After the Second World War, improvements were made that decreased the size of the antenna and electronic components, making RDF systems practical for aircraft, where they were so simple to use they were coined the

ADF, or automatic direction finders.

ADF systems have been largely supplanted by GPS.

Cathode-ray tubes weren't just useful for radar – all sorts of aircraft indicators were displayed with them.

For example, CRTs were used in the displays of radio detection finders, which used radio "beacons" broadcasting from destination locations such as airports and cities to guide aircraft in flight at high altitudes where navigating by landmarks was impossible. The electron gun inside the CRT drew a "compass needle" indicating the direction of the beacon, making it simple for the pilot to correct when the plane was off course.

CRT-based indicators were much easier to read in the dark, and thus assisted greatly during night flights. In aviation time is of the essence and gauges need to be clear and instantly readable. CRTs can do that!

However, despite the obvious advantages of CRT displays they wouldn't see widespread adoption until the 1980s, with many pilots insisting on continuing to rely on mechanical instruments in the meantime, thinking them more reliable and less prone to failure. When CRTs were finally accepted, the mechanical gauges remained as a backup!

Of course, in the modern era of "fly-by-wire" aircraft, where electronics sit firmly between the pilot and all aspects of aircraft mechanics, CRTs are the least of your worries...(modern aircraft are very safe.)



This close-up (above) shows the beam indicating that the ship is flying in the left of the proper course. Right rudder would make the line coincidental with the vertical index.

CRTs could also be used for in-aircraft radar systems as well. The C-Scope "bullseye" radar display shown in the image below was used by fighter pilots to line up enemy aircraft too far away to target accurately by sight.

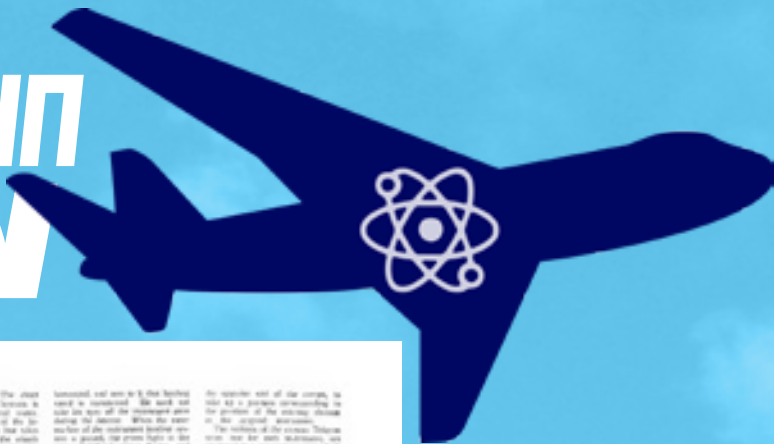
Some displays would change the colour of the target when it was within the scope's cross-hairs, indicating the perfect moment to fire! Once a target was "painted", some systems would automatically adjust the aircraft's direction to stay homed in on the target, the ultimate in "point and shoot" aerial warfare.



Here is the beam tube of the radio beam finder. Beam indicator with an arrow in the top of the window in the right hand of beam display panel.



ELECTRONICS IN MOTION



Recent and latest of flight instruments
Cathode-ray indicator in
flight instruments

By Don Fink

A DESCRIPTION of a very recent advance in the art of instrumentation is made in the latest issue of the Journal of the Institute of Electrical and Electronic Engineers, Inc., published in January 1949, by the Institute of Electrical and Electronic Engineers, Inc., New York, N. Y.

Specifically, the cathode-ray indicator is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot. It is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot.

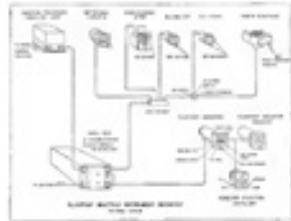


FLIGHTRAY
Ready for the Field

The cathode-ray indicator is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot. It is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot.

THE FLIGHTRAY system is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot. It is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot.

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FLIGHTRAY system is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot. It is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot.

The cathode-ray indicator is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot. It is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot.



FLIGHTRAY system is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot. It is a device which is used in the cockpit of an aircraft to display information in a form which is easily understood by the pilot.

Electronics are integral to most modern forms of transportation, from cars to planes to trains. In aircraft, electronics are pivotal to navigation, and cathode-ray tube displays made navigating easier.

The Flightray system, an early electronic flight instrument system (or EFIS) that combined a number of various mechanical gauges into a single CRT display. These included the artificial horizon, directional gyroscope, altimeter, air speed, "blind landing" radio receiver and radio compass or RDE.

Successors to the Flightray system would become known generically as "primary flight displays" units or PFDs, which would serve as the main indicators in aircraft with "glass cockpits" (a slang term amongst pilots for cockpits equipped with CRT-based displays).

A secondary display, known as the multi-function display (or MFD) came later, and is primarily used for displaying maps, flight plan and weather information.

In recent times, the CRTs have been replaced with LCD panels, which are lighter and radiate less heat.

There was quite a stir after the image to the right appeared in a 1949 issue of Aviation Week magazine. The woman "christening" the plane appears not to be holding a bottle of champagne, but a cathode-ray tube!

Readers were intensely curious about the aftermath of the image – did the CRT implode when it shattered, propelling shards of glass into both plane and people? Did those in the photo survive? What made them think of doing such a silly thing?

Well, happily the photographer was tracked down and all those questions were answered. It turned out the photographer was late, and the christening had gone ahead without them. There wasn't another bottle of champagne, but a CRT used in an aircraft indicator was found nearby, which was used to re-stage the scene.

april-june 2018

ANNOUNCING
a Revolutionary NEW
AUTOMATIC RADIO COMPASS
for use on ULTRA HIGH FREQUENCIES
also present Low Frequency Range

Friction 1.40,000,000 of 1 second

AIR SAFETY RADIO CORP.
Westchester Airport Armonk, New York
Telephone 2 Westchester-0300

COMPLETE DEMONSTRATION
on Jan. 1, 1949 at the Air Safety Radio Corp.
Armonk Radio Shop at Westchester Airport.

- 1. Provides accurate bearings, both in ultra high frequencies and in the low frequency range.
- 2. Ultra high frequency of bearing accuracy.
- 3. Completely automatic all right hand turn.
- 4. Fully automatically gear shift bearing and course distance from the transceiver station.
- 5. One in four on the new 1000 miles range in the present low frequency radio range.

THE AIR SAFETY RADIO CORP. because of the fact that it specializes in ultra high frequencies is proud to announce that it is the only company which has yet developed an automatic radio compass capable of operating on the new 1000 miles range as well as on the present low frequency range. Since our indicator is a laboratory indicator only, we have eliminated the friction and rotating position caused by the ordinary radio used to indicate the position in other sets. Furthermore the relative strength and distance indicators, which is an integral part of the cathode ray dial, has no need to use an external electronic reference circuit. Station, too, that our dial is set up in such a way as to show a large arc of bearing in a mere five degree arc. So, when in the station position what other set can help you, you can complete accuracy!

STRICTLY PERSONAL

CAPITAL CLEARS UP A BIG MYSTERY—We have just learned that the picture above created quite a stir in certain airline community circles after it ran recently in AVIATION WEEK. As soon as William T. Carnes, Jr., IWA's superintendent of radio engineering saw it, he wrote his friend at Capital, C. P. Blackman, supervisor of radio electrical engineering, as follows:

Dear Blackie: The christening of the Capital aircraft flight on page 48 of AVIATION WEEK Nov. 15 has aroused considerable discussion regarding the subject held by the actress supposedly doing the christening.

From where we are standing it looks very much like a 3 or 5 inch cathode ray tube, and if she really used such an object, the observers must have gotten a big "bang" out of the

[illegible]

"... Christened it in one hour, and the time it took it is always kept in the rear is on the hands of children. Again, now. May it bring many years of service, all concerned. I am only one of the ones who think a million."

NOW



The collage features three distinct elements. At the top left is a map of the United States. To its right is a newspaper clipping from the 'NEW YORK TIMES' with the headline 'NEW YORK TIMES'. Below the map and newspaper is a small black and white photograph of a person. At the bottom is a red book cover titled 'The Art of the Deal' by Donald Trump, which also features a small photograph of a person.

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AMERICA'S TOP 10

RANK	CITY
1	PHILADELPHIA
2	NEW YORK
3	LOS ANGELES
4	CHICAGO
5	HOUSTON
6	MIAMI
7	ATLANTA
8	WASHINGTON, D.C.
9	SEATTLE
10	PORTLAND, ME.

WGAL-TV

PHILADELPHIA, PA.

Kraft was first regular TV drama sponsor

109

However, radio was still the medium most adored by these companies, and television stations continued to struggle to gain sponsors. Some even resorted to offering to produce commercials for free – or even have the talent spruik sponsors' products for them. It was not uncommon for a character in a television drama or comedy stop in the middle of the action and talk directly to the audience about a brand of cigarettes!

Broadcasters also did whatever they could to increase their viewership. One tactic was to increase the size and power of their transmitting antenna as much as was feasibly possible – the KLVY-TV mast in Fargo, South Dakota was the tallest structure in the world when it was completed in 1963. At 629 metres (2063 feet) tall, it remains the world's tallest radio mast today.

Another tactic was to give away televisions – each TV netted an average of four additional viewers, and over the lifetime of both viewers and television the station was sure to make the money back from advertisers!

Eventually, most stations hit a “critical mass” of viewers that finally made television appealing enough to advertisers to spend real money on it – this allowed the stations to survive (although many early stations first lost money for years or even more than a decade in some cases).

But soon sponsors wanted to know when the most viewers were watching – that's where ratings came in.



Television stations needed to attract both “prestige” sponsors who would spend big bucks to advertise during “prime time” hours when the most viewers were watching, while also ensuring less-watched times of the day at the very least paid for themselves.

To attract prime-time sponsors, stations became affiliates of stations in larger markets that had bigger budgets to spend on programming. These “networks” of stations then largely aired an identical suite of prime-time programming, and tended to become identified with the network to which they belonged.

The off-hours were commonly used for local programming, which is why news bulletins usually occupied the 6pm supper hour and after 11pm when many viewers had gone to sleep.



By sending surveys to random households (often with cash or coupons to encourage participation), stations could determine which programs viewers were watching the most, and then charge a premium to advertise during their broadcasts. Eventually, third-party companies such as Nielsen began to conduct surveys that covered all of the stations in a given location, or market (after all, viewers could only watch one channel at a time!) This enabled television stations to tailor their programming to ensure the highest viewer numbers (and hence advertising rates) possible, leading to the modern commercial TV landscape.



THE BUSINESS\$

The PRO Shop

Back in the 1950s, when your surgeon wasn't concentrating on his golf swing, he was probably concentrating on his cardioscope – or at least you hoped he was!

The cardioscope was essentially a specialised oscilloscope – it displayed a patient's heartbeats on a cathode-ray tube as they happened, so that a surgeon or anesthesiologist could recognise irregularities early and take action. If the heartbeat stopped entirely a buzzer would sound.

The prior solution – the electrocardiograph (ECG) – used paper printouts, and as such was only switched on once a problem situation had been established – and potentially too late for the patient!

cardioscope

And so, real-time heart monitoring was a welcome innovation for both surgeon and patient. During the 1960s, monitoring cardioscopes became common at bedsides, and could be externally connected to additional monitors at nursing stations. Other enhancements that appeared over time included a looping magnetic tape recorder, which stored a rolling 15 seconds of electrocardio information that could be called upon in the event of a cardiac emergency, and a printer that could print out that information automatically.

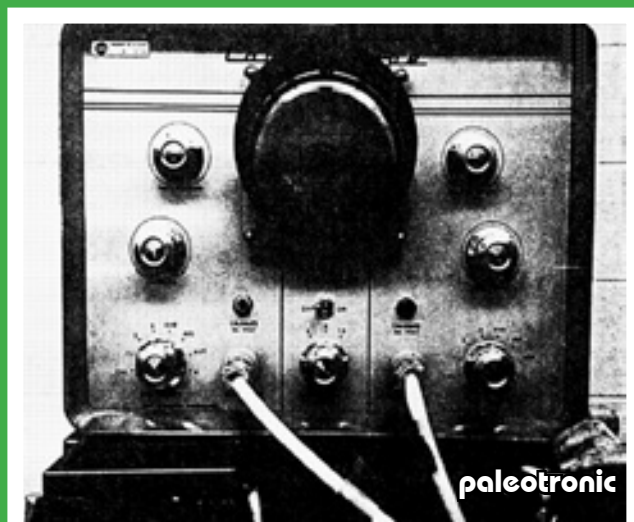
In the 1970s, transistorised units superceded earlier vacuum-tube based models, and the round CRTs were replaced with rectangular ones. Digital memory took the place of the magnetic tape loop.

The cardioscope is an electronic device to be "hooked up" to the patient in the same manner as is the electrocardiograph, which records heart action on paper. Each produces a cardiogram that shows whether the heart-beat is strong, weak, steady or irregular. In the cardioscope a beam of light moves across the face of the instrument, making a continuous electrocardiogram which tells the anesthetist what the patient's heart is doing throughout the time he is in surgery. Any irregularity in the movement of the light beam warns the anesthetist of danger, and in cases of cardiac arrest, where immediate heart massage may mean the difference between life and death, the cardioscope would instantly give the signal.

The Anesthesia Department, discusses CAPT E. R. Foster, Head of the Plastic, the only one of its kind in the East, with the patient's heart action during



Captain Gilman is the first military member to serve as a director of the hospital, where aim is to train



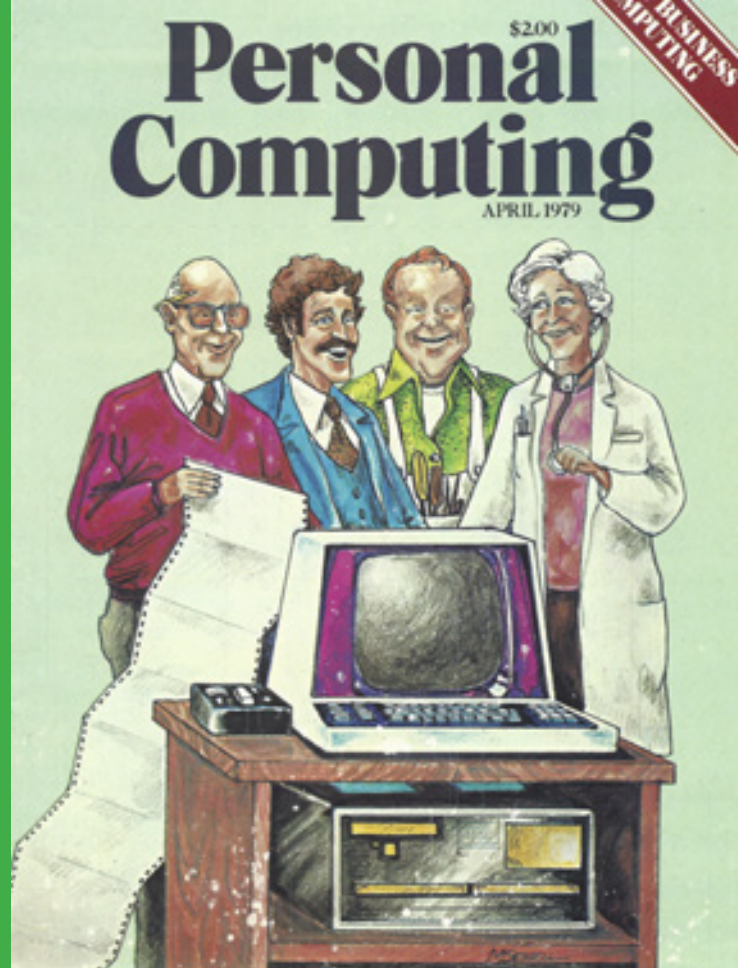
paleoTronic

The cardioscope wasn't the only place medicine found the cathode-ray tube handy...

Paper patient records had been used for hundreds of years, but had historically suffered from a number of issues. Firstly, there was usually only one copy, and that single copy could be partially or entirely damaged, inadvertently misfiled or completely lost.

Secondly, the only security was physical security – any one who had access to the file could modify it, or remove documents from it for whatever reason. And thirdly, there were multiple points of potential non-malicious failure, from the orderlies to the interns to the nurses to the doctors – any person who handled the file had the potential to lose or destroy some or all of a patient's record, causing vital information to become unavailable, and directly leading to “poor patient outcomes”, including death!

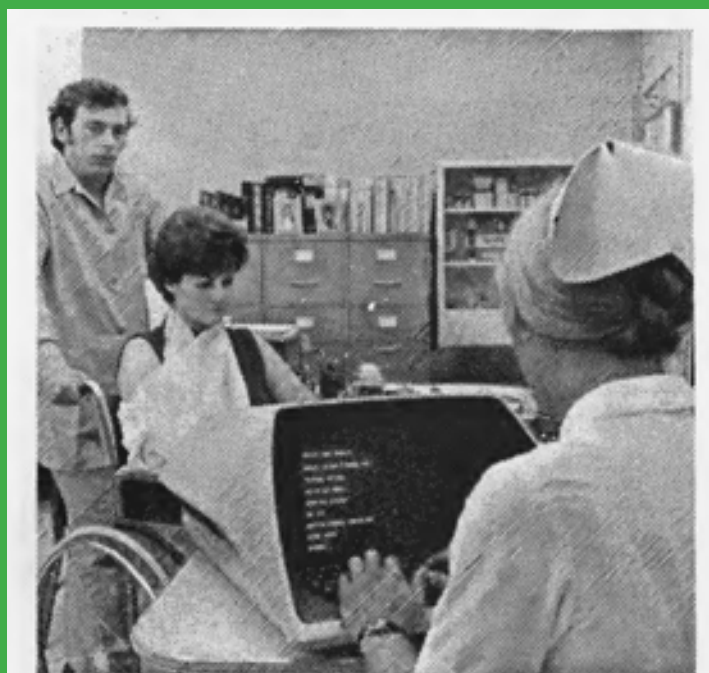
As mainframe computers became smaller, fitting into a room instead of taking up an entire building, some hospitals began to realise the value in maintaining digital patient records. These could be backed up, weren't easily lost or damaged, and had better security.



Computer terminals were placed at nurses stations, where patient information could be accessed, printed out for local department use, and updated as necessary. When a patient was moved, there was no longer any worry about misplacing their “chart” – it could just be printed out again, should that situation occur.

As personal computers became more readily available in the late 1970s and early 1980s, doctor's offices and surgeries got in on the digital record-keeping revolution, transcribing hand-written doctors' notes into computer databases and allowing paper files on former patients to be sent to “cold storage”.

Personal computers were also used to manage appointments and to check insurance coverage. In some areas, referrals to specialists could be made digitally, on-line pharmaceutical databases checked for potential patient drug interactions, and remote services could back up patient records and in some cases even provide a second opinion.



COMPUTERS IN HOSPITALS
CRT terminals are used in many hospitals to record medical information on patients being admitted. (Photo DEC)

All of these applications combined to streamline medical processes and improve patient outcomes – meaning more people got better and didn't die! Without the visual portion of the user interface provided by the cathode-ray tube, some or all of these innovations may not have occurred, at the cost of many lives.

Today, centralised patient record systems have been (or are in the process of being) developed in many areas, to easily allow patients to move from one physician to another, and to ensure up-to-date information is always available to hospitals and EMTs.



CRTs in Medicine



Electronics Australia was Australia's longest-running electronics magazine, dating back to 1922 when its predecessor Wireless Weekly launched. It subsequently had other names, becoming EA with the advent of computing. EA published its last issue in 2000.

Pong: or, how I learned to love getting paddled.

In the 1960's television was something that was a passive occupation, you turn it on and it entertained you. The possibility that you might be able to create or manage what you saw on the television was science fiction.

The system as it was designed was based on a phosphorescent dot traveling across the screen with a horizontal frequency of 15,734 Hz and a vertical frequency of 59.94 Hz (NTSC). This gave 525 lines in each field and a frame rate of 29.97 Hz.

This system was perfect if what you were doing was scanning an object (someone's face) and then transmitting it to a television in another town. But what if you want to put the ball of a Pong game on the screen. You have to recreate the horizontal and vertical frequencies and synchronise those with your ball object. For example, if the ball was in the center of the screen you would have to have a jump the video signal every 33.3 mS (milliseconds) after the start of the frame.

So in order to play Pong you need a device that will create all the necessary synchronizing frequencies and move the paddles and dots around. There are two ways to do this analog and digital. The digital process is very easy in today's technologies, Buy a PIC (Programmable Intelligent Computer) microcontroller and there are a number of small programs that will display a Pong game – all you have to do is make the controllers.

The analog version is harder to do. There was a Pong game that was featured in Electronics Australia in May of 1976. It used some digital components yet it is analog in design.

The circuit is designed on the 74C series CMOS logic quad NAND gates and 74C series NOR gates (see explanation at bottom of page).

Five NAND gates, 1a,1b,1c,1d, and 3a are connected as a free running horizontal sweep oscillator. The horizontal frequency control is set to give a frequency of about 15625 Hz. This oscillator produces the left bat, right bat, line sync and center line for the display.

Four NAND gates, 2b,2c,2d, and 2a are connected as another free running oscillator, running at 50 Hz. This is the vertical signal for the display. The frame sync, the upper line, the net height and lower line are produced by signals from this oscillator.

The line sync and frame sync pulses are added together by gate 3b, to form a composite sync pulse then injected into the video line by TR4. The line sync and frame sync pulses are also used to generate line and frame ramps. The line ramp is produced by D9 and its associated components. The ramp is positive going, and is reset when the LS pulse discharges the 330pF capacitor through D9 and the 1k resistor.

This is an **advanced** project, which requires soldering and circuit board printing.

Websites that describe how to solder:

<https://www.build-electronic-circuits.com/how-to-solder/>

<http://www.instructables.com/id/How-to-solder/>

Websites that describe DIY circuit-board printing methods:

<http://www.instructables.com/id/Creating-Printed-Circuit-Boards-with-a-INKJET-Printer/>

<https://maker.pro/pcb/tutorial/how-to-make-a-printed-circuit-board-pcb>

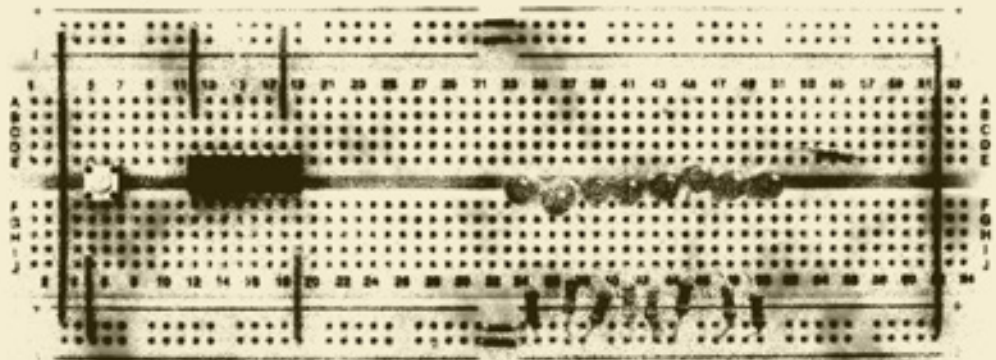
Also: YouTube!

NAND gates and NOR gates are logical circuits made out of **transistors**. Logic gates take two binary inputs (on[1] or off[0]) and then produce a single binary output, depending on the type of gate. For example, an **AND** gate will only return 1 (on) if **BOTH** inputs are 1. An **OR** gate, meanwhile, will return 1 if **ANY** input is 1.

Our Pong machine uses **NAND** gates, which act in the reverse to **AND** gates, returning 1 in all cases **EXCEPT** when **BOTH** inputs are 1, and **NOR** gates, which act in the reverse of **OR** gates and **ONLY** return 1 when **BOTH** inputs are 0. By using IC chips containing multiple **logic gates**, combined with **capacitors**, the game objects can be created, and overlaps between objects (e.g. ball and bat) can be detected.



A new look at an old favourite, by Donald J. Griffiths.



THE BREADBOARD

Horizontal Oscillator Section:

See schematic on next page

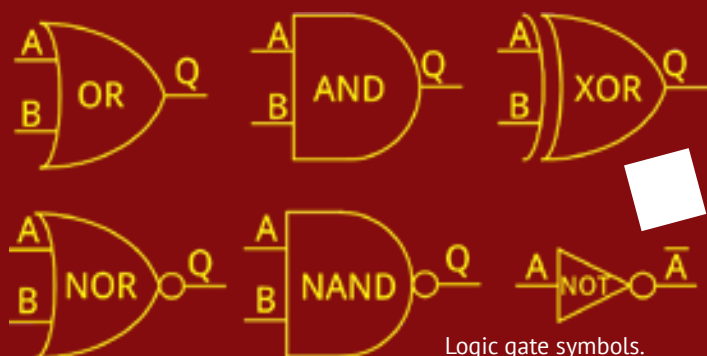
Other Sections:

Reference Point	Name	Purpose
BL	Bat Left	Generates pulses that positions the left paddle aka. bat.
BR	Bat Right	Generates pulses that positions the right paddle aka. bat.
CL	Center Line	Generates pulses that positions the dotted center line.
LS	Line Sync	Generates the horizontal pulses, which I believe is the "base" frequency (15,750Hz for the U.S.).

Reference Point	Purpose
A	Generates vertical signals to move the left paddle up or down.
B	Generates vertical signals to move the right paddle up or down.
C	Generates vertical signals to move the ball up or down.
D	Generates horizontal signals to move the ball right or left.
E	Signal to put the upper line (UL) and the lower line (LL) into the video.
F	Signal that drives TR1 for some vertical movement of the ball by player 1.
G	Signal for horizontal movement of the ball and for serving the ball in one direction.
H	Signal for horizontal movement of the ball and for serving the ball in the opposite direction of above.
J	Signal that drives TR2 for some vertical movement of the ball by player 2.
V+	9V+ source. This should be self-explanatory.

Vertical Oscillator Section:

Reference Point	Name	Purpose
FS	Frame Sync	Generates the vertical pulses, which I believe is the "base" frequency (60Hz for the U.S.).
UL	Upper (Top) Line	Generates pulses that positions the top line
LL	Lower (Bottom) Line	Generates pulses that positions the bottom line.
NH	Net Height	Generates pulses that positions the dotted center line between the upper and lower lines.



Logic gate symbols.

Hours of fun for the whole family!

Build your own Video Ball Game

Do you find TV programs boring? If so, help is at hand. Our Video Ball Game will provide hours of fun, for all your family and friends. Using only thirteen CMOS ICs and a number of discrete components, the kit is easily assembled on a printed circuit board.

by DAVID EDWARDS

In recent months a large number of home video games have come onto the market. These usually cost in the vicinity of \$100.00 or more, and are available either as fully assembled units or as kit forms. Our Video Ball Game should cost you considerably less than this to construct—in fact it should cost you only about \$40.

Used in conjunction with a standard VHF TV set, either colour or black and white, the unit produces a display similar in outline to that of a tennis court or ping-pong table. There is a central dotted vertical line, called the net, and upper and lower boundaries from which a small rectangular "ball" can be bounced.

Along the side boundaries may be moved small "bats", which can be controlled by two players using small hand-held units. The players move their bats up and down, hitting the ball to keep it in play. A player scores a point when his opponent misses the ball, and allows it to continue off the court.

The ball is brought back into play by pressing the opposing player's hand-held unit. Each player is provided with a hand-held unit, buttons on his control unit.

The speed at which the ball moves, and hence the rate of play, is varied by a control on the front of the case.

Small slider switches are used to alter the display, allowing several types of games, by one or two players, to be played.

Turning now to the main circuit diagram, we can see how the display is produced, and how the design is implemented. The 74C00 logic has been used in the design, with gates functioning both in the normal digital manner and also as linear amplifiers. In addition to the CMOS gates, four discrete transistors have been used, as well as a number of diodes.

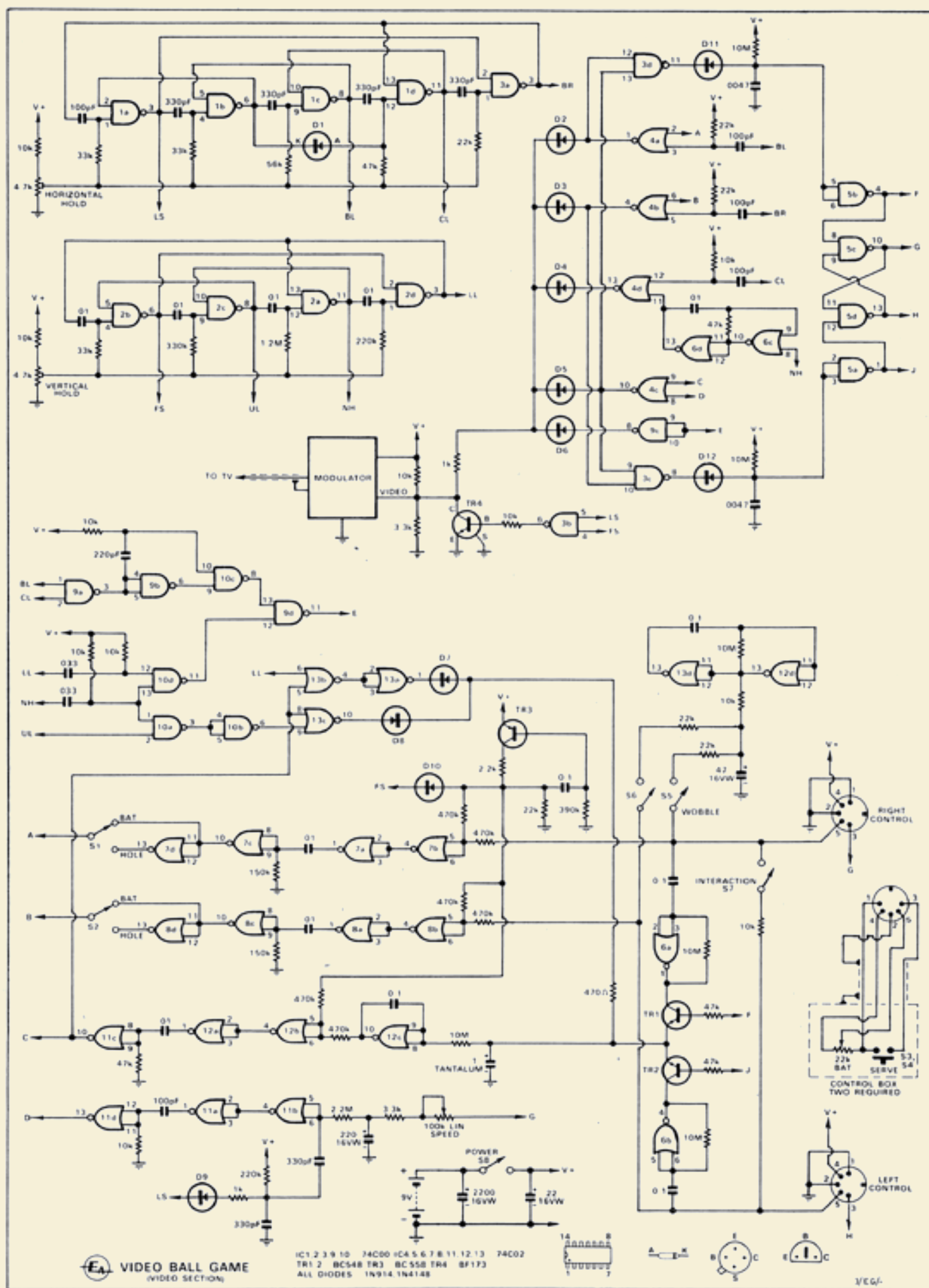
The box labelled "modulator" is a self-contained unit, which converts the video information generated by the remainder of the circuit into a form suitable for decoding by a standard VHF TV set. It is connected directly to the aerial terminal of the TV, and is described in more detail in the article, commencing with a detailed description of the circuit operation, see page 114.

Five NAND gates, 1a, 1b, 1c, 1d and 1e are connected in a free running horizontal energy oscillator. The horizontal hold control is used to set the operating frequency to about 15625Hz, to operation, a "line" pulse circulates through the gates, producing appropriate outputs at each gate. On ensures reliable starting and operation.

The line sync (LS), but left (BL), centre line (CL) and ball right (BR) pulses produced by this oscillator determine the horizontal spacing of the display.

Four NAND gates, 2a, 2c, 2d and 2e are connected in another free running oscillator, this time with a frequency of about 30Hz. This oscillator produces the frame sync (FS), upper line (UL), net height (NH) and lower line (LL) pulses, which determine the vertical spacing of the display.

The LS and FS pulses are added together by gate 3b to form the



The frame ramp is produced by TR₃ and its associated components. A linear positive going ramp is produced as the 0.1uF capacitor discharges through TR₃. The capacitor is charged by the frame sync pulse, via D10.

Gates 6c and 6d are connected as a free moving oscillator with a frequency of about 100 Hz. This oscillator is gated on and off by the NH pulse connected to pin 8. The oscillator is combined in gate 4d with a differentiated CL pulse, and injected into the video line by D₄. This forms the central dotted line that serves as the net.

The 22k bat controls are connected as potential dividers across the supply lines. The bat voltages are added to the frame ramp at the inputs to the gates 7b and 8b. These gates act as comparators, and produce negative going transitions at their outputs whose positions with respect to the FS pulse vary directly with the positions of the bat controls.

These edges are squared up by gates 7b and 8b and then differentiated. The differentiator time constants determine the vertical heights of the bats. The differentiated pulses are squared up by gates 7c and 8c, and the inverted by gates 7d and 8d. The bat pulse or their complements are selected by S₁ and S₂ and the passed to the inputs of gates 4a and 4b.

The BL and BR pulses are differentiated and fed to the remaining inputs of 4a and 4b. The width of these differentiated pulses determine the horizontal widths of the bats. The horizontal and vertical components of the bats are summed by gates 4a and 4b, and injected into the video line by D₂ and D₃.

As with the bats the horizontal and vertical components are generated separately. The vertical velocity of the ball is represented by the voltage stored on the 1uF tantalum capacitor. This velocity is integrated by gate 12c, and the resultant voltage that represents the vertical position of the ball is added to the frame ramp at the input of gate 12b, to produce a negative going edge representing the vertical position of the ball.

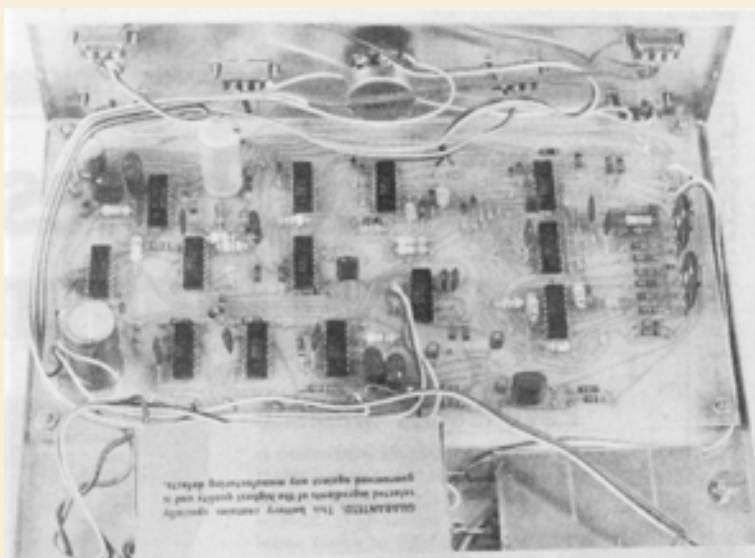
This edge is square up by gate 12a and the differentiated to produce a pulse proportional to the height of the ball. This pulse is squared up by 11c, and fed to one input of gate 4c, and to the inputs of gates 13b and 13c.

Consider first the case when the ball is descending. The 1uF capacitor will be charged to a higher voltage than the threshold gate of 12c, and its output will be falling. When the ball reaches the bottom of the screen, gate 13b will register a coincidence between the ball pulse and the LL pulse. The resulting output pulse is inverted by gate 13a, and discharges the 1uF capacitor via D₇ and the 470 ohm resistor.

The integrator output will now commence to rise, and so the ball will bounce off the lower line, going towards the upper line. When this occurs a coincidence is registered between the ball pulse and the delayed upper line pulse.

The positive pulse from gate 13c will now charge the 1uF capacitor again, via D₈ and the 470 ohm resistor. This moves the ball back towards the lower line.

The voltage on the 220uF electrolytic capacitor represents the horizontal position of the ball. This voltage is added to the line ramp at the input of gate 11b, producing the negative going transition at the output corresponding to the horizontal position of the ball. This is squared up by gate 11a, differentiated, and squared up again by gate 11d. The width of the ball is determined by the differentiator time constant.



This shot from the rear shows clearly the internal disposition of the component parts. The modulator assembly is shown in the lower right hand corner.

Electronics Explained & DIY Projects



The horizontal and vertical components of the ball are added together by gate 4c, and the injected into video line by D5. Gates 3c and 3d detect coincidence between the ball and the left and right bats. These coincidence pulses are stretched by D11 and D12 and their associated circuitry, then squared up by gates 5a and 5b.

The gates 5c and 5d are connected as a flip-flop, and used to control the horizontal direction of the ball. If the ball is moving to the right then the output of gate 5c will be low, and the 220uF capacitor will be discharging via the 100k speed pot and limiting resistor. If the ball hits the right hand bat then gate 3d will register coincidence, and gate 5b will toggle the flip-flop. The 220uF capacitor will now begin to charge up and the ball will move to the left. When the ball hits the left bat the direction is reversed again.

If the ball misses one of the bats, the flip-flop is not toggled and the ball continues past the bat and off the screen. Eventually the 220uF capacitor becomes fully charged or discharged, and a stable state is reached. The ball is returned by pressing the serve button which toggles the flip-flop.

The upper and lower line on the court are generated by gates 9a, 9b, 9d, 10c and 10d. These combine BL, CL, LL and NH pulses to produce the required video signal which is injected into the video line by gate 9c. Gates 10a and 10b are used to delay the UL pulses, so that the ball bounces off the bottom of the upper line.

Gates 13d and 12d are used to form a very low frequency oscillator. The output from gate 12d is filtered by a RC network, and used to wobble the bats up and down, under the control of switches S5 and S6. Switch S7 connects the wipers of the two bat controls together via a 10k resistor, to provide interaction if this is required.

PARTS LIST

Semiconductors

5 74C00 quad 2-input gates
8 74C02 quad 2-input gates
1 BF173 NPN transistor
2 BC548 NPN transistors
1 BC558 PNP transistor
12 1N4148 Silicon Diodes

Resistors

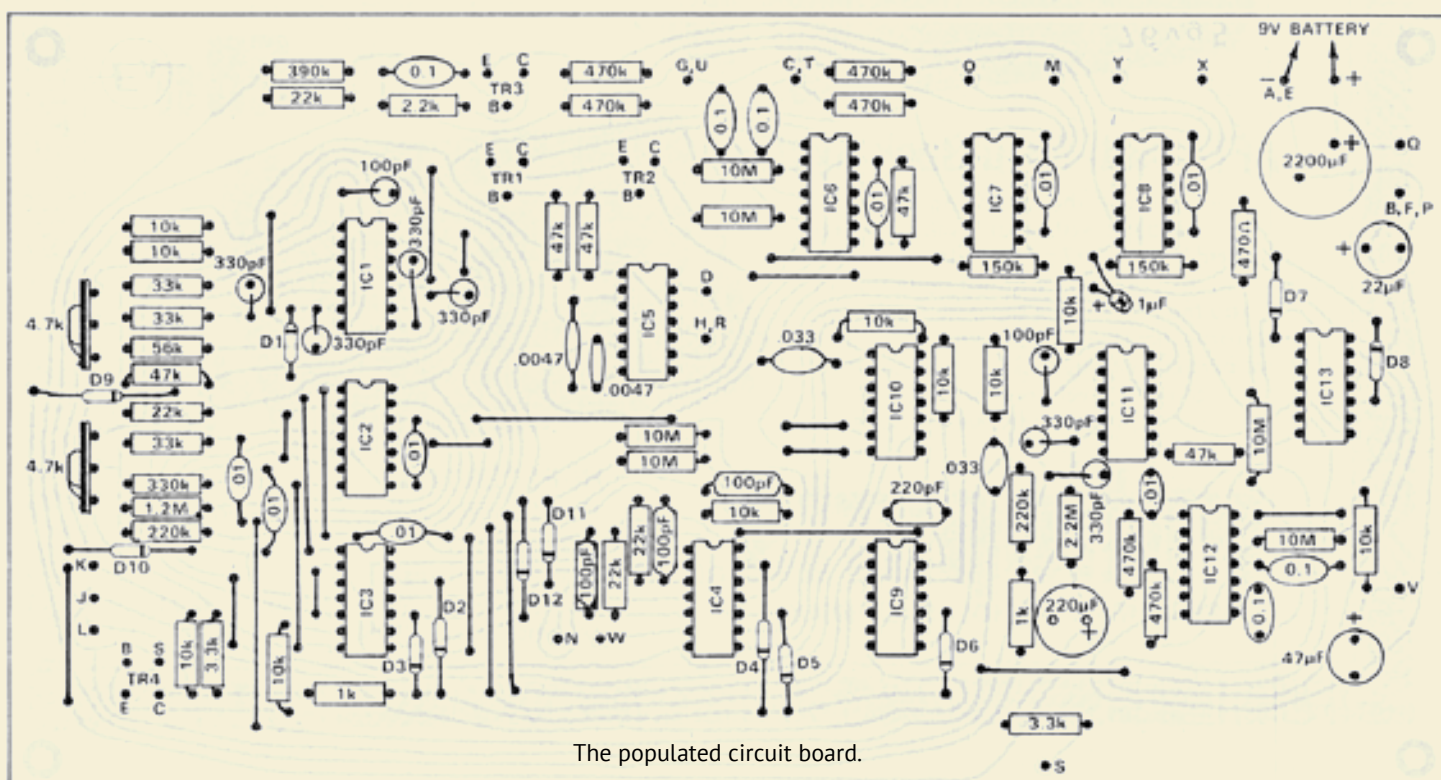
1 470ohm, 2 1k, 1 2.2k, 2 3.3k, 11 10k, 6 22k,
3 33k, 5 47k, 1 56k, 2 150k, 2 220k, 1 330k,
1 390k, 6 470k, 1 1.2M, 1 2.2M, 6 10M.
2 4.7k trim pots
2 22k linear pots
1 100k linear pot

Capacitors

5 100pF polystyrene
1 220pF polystyrene
6 330pF polystyrene
2 0.047uF LV polystyrene
8 0.01uF LV polystyrene
2 0.033uF LV polystyrene
5 0.1uF LV polystyrene
1 1uF tantalum
1 22uF 16VW electrolytic
1 47uF 16VW electrolytic
1 220uF 16VW electrolytic
1 2500uF 16VW electrolytic

Miscellaneous

6 DPDT slide switches
2 miniature momentary "on" pushbuttons
2 5-pin DIN sockets
2 5-pin DIN plugs
1 printed circuit board 221 X 122 mm
3 Knobs
2 2-meter lengths of 5-core shielded cable
2 plastic boxes 80 X 50 X 28mm
1 aluminium case 230 X 205 X 68 mm
1 RF modulator assembly, removed from old VCR.
3 grommets
4 rubber feet
1 9V battery



The populated circuit board.


The construction of the game is quite simple, almost all the components are mounted on the printed circuit board. There is a separate board for the modulator. Do not remove the CMOS ICs from the protective packaging until they are to be inserted in the PCB. All other components should be fitted first.

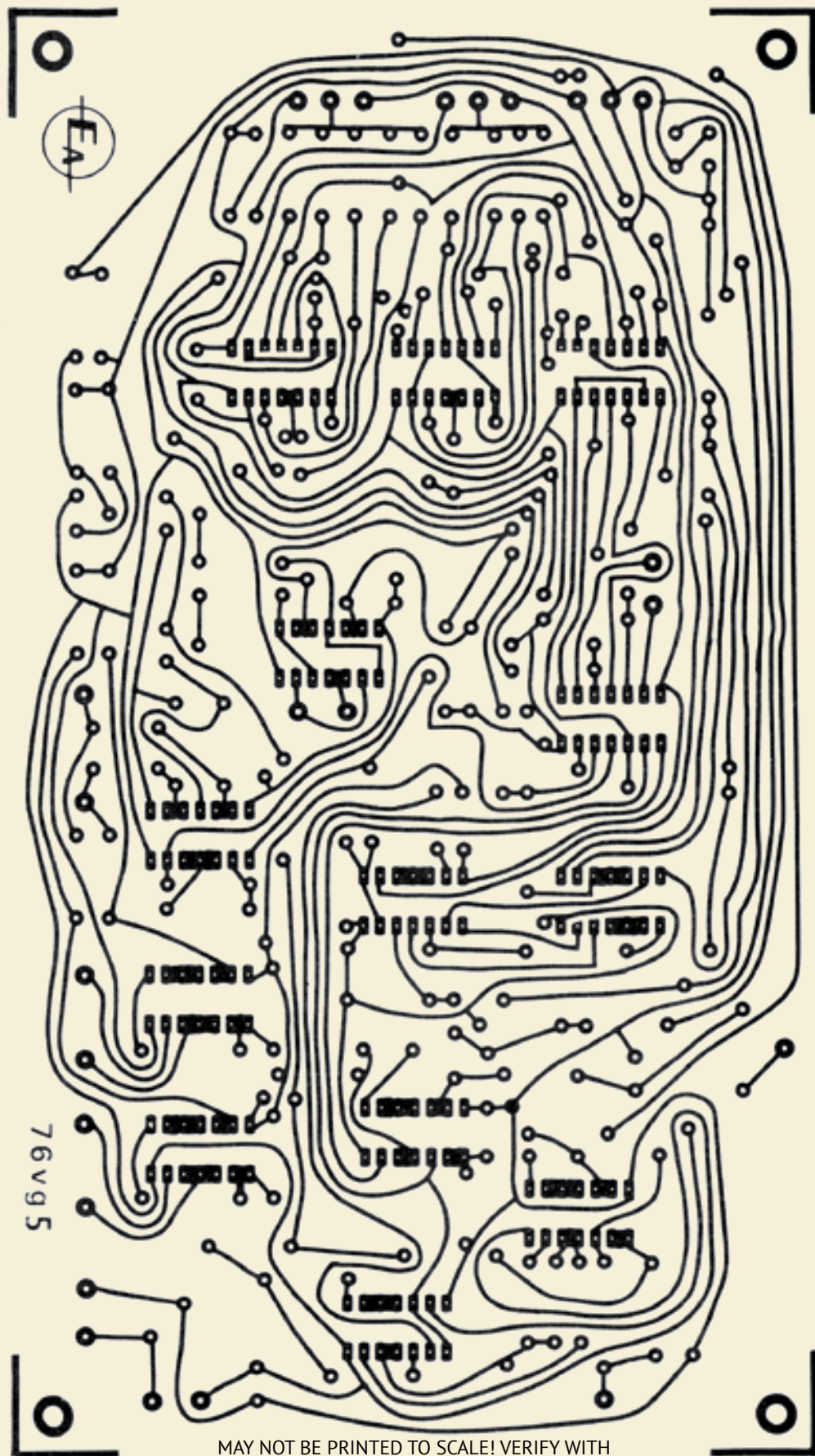
There are 23 wire links to be fitted to the board, none of which need to be insulated.

Next mount all the resistors and capacitors, making sure the polarity is correct for the capacitors. The twelve diodes and the four transistors are fitted next. Be careful of the orientation of the transistors.

The CMOS IC's are inserted next. When soldering them to the board insure that the tip of the soldering iron is grounded. Solder the pins at opposite corners of the IC first, pins 7 and 14, then do the rest of the pins.

The original build had a modulator board, however there are modulators in old VCR's that will work well in this application.

This was a very ingenious way to create a Pong game and I think Magnavox used something like this, in the early days. What it does point out is the large experience with analog circuits and the high cost of doing this as a digital device at the time. In the years since the cost of the digital version has dropped to a very low price such that it is now easier to do a software version of an analog signal then it is to design the circuit. 



“This was a very ingenious way to create a Pong game and I think Magnavox used something like this, in the early days.”

The Sliced Salami Society **MURDERER** investigates the... by Melody Ayres-Griffiths **ON CHANNEL 4**

Vera did as he had done for so many Tuesday nights before: she made her cup of tea, got her little biscuits from the tin above the sink, and headed for her living room, sitting down on her tidy green sofa and clicking on the television and her Telecaption closed-captioning box for her weekly dose of Murder, She Wrote.

She turned to acknowledge her husband Joseph, sitting beside her on the couch in spirit, and settled in for an hour of intrigue and (for a 78 year-old) excitement. But, while Jessica Fletcher was interrogating suspects in her charming, Cabot Cove way, a ghostly image appeared on the screen, superimposed over Vera's favourite program. She strained to make it out – it appeared to be a message of some kind, written in block letters, but different from those made by her Telecaption box.

It gradually said, "I'm going to kill you." Then it faded out, and Murder, She Wrote returned to full strength. It was 8:30pm.

Vera was stunned. Her Telecaption box must be acting up, she thought. But after Jessica Fletcher had apprehended the murderer and the credits began to roll, the ghostly message came back. "I mean it, Vera Weinerburger, I'm going to kill you!" It vanished as quickly as it appeared.

Poor Vera almost joined her husband right there and then! She clicked off her TV in fright, and rushed to her TDD, a teletypewriter for those who, like Vera, were severely hearing impaired, then dialing the police. The TDD operator was empathetic but said there wasn't anything he could do for her. He implied she imagined it! "I've lost my hearing, not my mind," Vera wrote back, disconnecting in a huff.

Who could help her with this? If Murder, She Wrote had taught Vera anything, it was that you had to get them before they got you. She struggled to think. She needed someone technical – oh, she knew the perfect person, her nephew Stephen. He ran a shop in Vera's town of Schenectady – a computer shop. If anyone could help her find her prospective killer, it was Stephen!

Steven didn't have a TDD, so Vera wrote a note for her postman, Sam, to get to Stephen. He was good that way, but it was snowing heavily outside, and Vera prayed he would be able to deliver it. She needed this case solved quickly – before the killer could make good on his threat.

There was a knock on the door. "I got it," twelve year-old Jamie Silicon called out, more flying down the staircase than running. "Oh, hey Sam", Jamie said to the imposing postman standing in front of him, covered in snow. "School's closed today. Snow day, but you already know that, obviously. What's up?"

"Er, hello Jamie." The big man shifted nervously. "Um, is your Dad also 'Stephen Weinerburger'?" Sam wasn't sure he was at the right house, but given the content of the message this was his best guess. Jamie laughed.

"Yup, that's him, the old Weinerburger." Jamie grinned. "Why d'ya think we changed our name? What'd he do?"

Sam tried his best to keep a straight face and be professional. "I've got a message for him. This nice old deaf lady named Vera a few streets over thinks there's a man in her television that wants to kill her?"

"Sarah!" Jamie shouted. "Do we know an old lady named Vera?"

Released in 1983, the Adam was Coleco's attempt to create a home computer successor to its ColecoVision video game console. However, its initial pre-Christmas production run was limited due to manufacturing problems, and many of the Adams that were shipped were defective. Due to subsequent negative press consumers were turned off and sales were poor. Coleco discontinued the Adam in 1985.



"That's great-auntie Vee," Jamie's slightly older sister shouted from the offices of her detective agency, located in the walled-in back porch of their two-and-a-half story Victorian. "With the tin of biscuits."

"Oh yeah, great-auntie Vee." Jamie looked back up at Sam. "Looks like you found the right place. We'll take it from here."

Sarah appeared from the back. "What's going on?"

"Great-auntie Vee thinks her television is trying to kill her"

"No, she said someone in her television is trying to... look, here's her note. I have a lot of mail to deliver still and it's cold out here!" Sam tossed Vera's note down at Jamie, turned and trudged off down from the front verandah. "Make sure you give it to your Dad!"

"Dad's away on business until... oh never mind. Sam could really stand to work on his demeanour," Jamie deadpanned, turning and handing the note to Sarah. "Here, you know how to read good..."

Sarah scanned over the note. "Great-auntie Vee says that a ghostly message on her TV appeared last night threatening to kill her, personally. Tonight. This sounds like a job for the Sliced Salami Society. We should go over there."

"Well, I better bundle up the squirt then," Jamie said, referring to their younger sibling Pippin. "Can we take the sled out?"

Vera was surprised to find three children she only vaguely recognised standing on her porch. She beckoned them inside and led them over to her TDD. She didn't like to talk, apparently she shouted and Vera didn't like to shout. "Who are you again?" she typed.

"Your nephew Stephen's children," Sarah typed back. "We're here about your note."

"Oh. What can you do?"

"We investigate things like this."

Vera wasn't terribly confident three children could help her out of her predicament, but given there currently wasn't anyone else, she thought she may as well let them try. "It happened while I was watching Murder, She Wrote last night," she typed. "There was some strange words on the screen from a man who said he was going to kill me. Vera. Tonight. He knew my name." She began to feel panicked again.

"Can you think of anyone who would want to kill you?"

"Heavens no!" Vera was insistent on that point. "Let me show you my TV". Vera led them into the living room and switched it on.

"We watched Murder, She Wrote last night and there wasn't any words," Jamie noted lackadaisically, lingering in front of the fire burning in a fireplace in the opposite wall. The picture tube warmed up and a soap opera appeared on the screen, along with

closed captioning scrolling at the bottom. Jamie thought he'd solved it already. "Oh! You mean these words?"

"That's the closed captioning, Jamie," Sarah said, "For people who are hard of hearing."

"But are these the words great-auntie Vee saw? Maybe it was just a glitch in the, uh, closed...?"

"Closed captioning." Sarah looked questioning at Vera, who had grasped enough of the conversation to shake her head no. "No. I don't think it was. But one thing I do notice is this TV is on channel 4, when this station is actually channel 8. The closed captioning box must also act as a tuner for the TV." Sarah's forehead scrunched in thought while Pippin gurgled a muted cheer at a colourful cereal commercial. "That would explain why we didn't see it. Nobody would have seen it, there's nothing on channel 4."

Jamie's attention had wandered to pictures on the mantle over the fireplace, particularly a black-and-white one that looked like a younger Vera in fancy 1920s garb. He turned to Vera and pointed to it. She went over to a desk, opened the big drawer at the top and rummaged through some papers, pulling out a slightly yellowed and tattered old magazine. She opened it and flipped through the pages carefully, landing on her destination and beckoning Jamie over.

"The Queen's Messenger'," Jamie read, slowly. "'The first television drama'...hey, that's you again," he said, pointing at the corner of the page. "'Local Schenectady stage actress, young Vera Weinerburger had a small part in the program...' Hey, you're famous!"

The General Electric Octagon television used a design similar to John Logie Baird's system. A spinning Nipkow disk passed in front of a lamp, whose brightness varied based on the strength of a radio signal. A lens enlarged the image.

The Octagon was made in 1928 as part of GE's television trial in Schenectady, New York, and only five still exist today. The unit pictured below is a replica, produced by GE in the 1950s as part of a promotion detailing its place in television history.





Remember?

... this scene from the first television drama ever produced. "The Queen's Messenger", in 1928 by the General Electric Company's experimental television station, WRGB's smooth and efficient programming today is a result of this first experiment and 26 years of television experience. With this background, WRGB brings the finest service to advertisers and audience through 361,600 sets in WRGB's 14,000 square mile area.

Vera smiled, thinking back to the hot lights, and the noise of the flying-spot cameras. "Impressive," Sarah interjected, still fiddling with the television, "but not the 'I want to kill you' kind of famous. I think that's a 'red herring' as Holmes would say. We should canvass the neighbourhood. I have a suspicion..."

The children began knocking on doors. Because of the snow, everyone was home. "Do you have a computer?", Sarah asked the woman, Sandra, at the first house, and to everyone at every house afterwards. Some did, most did not. Those who did invited the children in to show it off. There was an Apple II, a Commodore 64, an Atari ST and others. Jamie and Pippin had to play-test all of them, and Sarah had to drag her siblings away every time.

There was also plenty of hot chocolate, so much Pippin began to noticeably vibrate. But, according to their owners, none of the computers had been on the previous evening – and none of those owners appeared the type to threaten an old woman.

If the ghostly words on Vera's TV hadn't called her by name, Sarah would've chalked all of this up to accidental radio-frequency noise from a text adventure or someone writing a novel. But the fact there apparently weren't any computers on – that anyone was willing to admit to, anyway – and Vera's name was used (Sarah had no reason to doubt the word of her great-aunt) made it all seem a little too sinister for Sarah's liking.

"Someone has to have lied to us", Sarah declared, in earshot of the kind-looking older widower, George,

who was preparing their ninth cups of hot chocolate in the last house that Sarah estimated could conceivably leak RF interference as far as Vera's.

"Well, it wasn't me," George said. "I was watching Murder, She Wrote, not using the computer. Besides, it's broken anyways. I have an idea for you, however." George was an old television engineer, and he proposed that they attempt to "triangulate" the signal. "I have some old signal meters you could use. If the message appears again, I'll measure the signal from here, Jamie can measure it at your great aunt's, and Sarah at another house on the other side of your great aunt's from mine. Then maybe you could narrow down the location of your phantom."

Sarah agreed with George's plan, and later that evening, with Pippin stowed safely back at home, she and Jamie snuck out, the boy heading to Vera's, and Sarah to the house of Wendy Chalmers, a real-estate agent living equidistant from George. At 8:30pm the messages re-appeared. "There's not much time left, Vera. I'm going to enjoy ending your pathetic life."

Sarah didn't recognise the type as belonging to any computer she had ever seen before. Luckily Vera didn't see it. She had gone to bed early, thinking that ignorance in this case was probably bliss.

The signal was weaker at Wendy's house, but George reported no signal strength at all. Based on the evidence, the perpetrator had to be living somewhere between Wendy's and Vera's. But Sarah potentially had other leads to chase up tomorrow. She didn't elaborate and thanked George on the telephone, wishing him a good night.

Her tone was distinctly different, however, when she turned up next morning on his doorstep. "You lied to me," Sarah growled, holding a stack of papers in her hand. "I delivered surveys yesterday afternoon to the whole area, including all of your neighbours, and asked them to watch last night too. They saw it. Your neighbours all saw it. Clear as day. Do I need to call the police?"



1928: First live drama in U.S. It was now-forgotten vehicle called "Queen's Messenger" televised in crowded General Electric studio in Schenectady. Present WRGB evolved from these early efforts.

The Queen's Messenger was the first live TV drama broadcast in the United States, in 1928.

"Ho—hold on a minute. You don't need to go and do that." the sleepless George sighed – his worst fears confirmed – pondering his options, and settling on telling Sarah the truth.

"Okay, you've got me. I've been writing a murder mystery centred around the Queen's Messenger broadcast. Your great aunt Vera figures in it: the murderer is a Vaudeville theatre fanatic and tries to persuade her to not participate in the broadcast by sending her threatening notes hidden in bouquets of flowers. He then plots to kill everyone involved in the broadcast in an attempt to stop it, thinking the television will eventually destroy his beloved Vaudeville. He was right, of course..."

"Why didn't you just tell us that? It would've saved us all a lot of trouble!"

"I'm not writing it for myself, I'm 'ghost writing' it for another author. Yes, I understand the irony. It's someone you've probably heard of. Someone who 'writes' a lot of books. Obviously it can't get out that I'm writing a book with an extremely similar yet very niche premise. I also didn't want your great aunt to find out in case she tried to stop it from being published. Bloody Coleco Adam! I wrapped tin foil around it last night, but obviously it didn't help. Why do I keep using that old piece of junk? Serves me right for buying a computer from the Connecticut Leather Company."

"Coleco Adam!" Sarah wrinkled her nose. "That explains why I didn't recognise text. You should have just taken the night off. Why didn't you? Why take the risk?"

"Pardon the pun, but I'm on a tight deadline. Also, doesn't the murderer always want to get caught? At least in silly murder mysteries, in any case."

"A murder mystery? About me? Of course I don't mind, I'm flattered." Vera finished typing and smiled at George, the widower having been marched over to her house by Vera's annoyingly insistent great-neice.

"Sorry for frightening you," George

replied. "It wasn't my intention. It was just a book. I write them because I'm lonely. Because I'm alone."

"Not at all. I completely understand. All of it." She paused before continuing. "You can make it up to me by coming over for dinner some night..." Vera didn't think Joseph would mind. After all, how often in life does your own 'killer' come for supper?

"So that's what you get up to when I'm away," Stephen Silicon shook his head in a confused mixture of disbelief and amazement. "I should hire a nanny."

"We can take care of ourselves, Dad," Sarah retorted. "Maybe you should stop leaving, if it bothers you that much..."

"Shush!" Jamie interrupted. "Macgyver's back on!"

Cheesy 1980's action resumed. But just as Macgyver was about to save the day with a bent paperclip, RF interference began to distort the screen and ghostly words appeared.

"Congratulations on solving the case, SSS. I'm looking forward to meeting you. It's been a long trip. I'll be seeing you very soon. Konichiwa!" Then, they were gone.

"That's odd. What's that about? SSS?" Stephen stood up to play with the TV's rabbit ears.


"Never mind, Dad," Jamie sang cheerfully, recovering from a momentary sense of dread. "It's nothing. Right, Sarah? It's nothing, right?"

"Right," Sarah said, tentatively, a bit nervously, before taking a breath and renewing her rapidly waning confidence. "Nothing we can't handle." It appeared the Sliced Salami Society already had another case.

Theirs. 

The Coleco Adam's printer was also its power-supply! In order to differentiate it from its competitors, the Adam shipped with a printer by default. It had a built-in electric typewriter mode where typing on the computer's keyboard instantly translated to text printed on paper, in order to appeal to those unaccustomed to the idea of word processing.

But if the printer died, so did your computer! This makes finding working Adams today rare.



Would you like to
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Ask The Readers

The Editors And Readers of COMPUTE!

THE DEAD computers on

commodore

VIC-20

In order to encourage sales of home computers in the 1980s, most manufacturers added an "RF modulator" which relocated the frequencies of the computer's composite video signal onto a standard TV broadcast channel. To say the quality was variable would be a huge understatement, and new owners weren't always happy with what they got...

VIC Zenith Jitters

I just recently purchased a VIC and own a Zenith TV set. The computer does not work on the Zenith because of vertical hold problems. There is a single POKE command (POKE 36864,133) which corrects this problem. Some preprogrammed tapes and some cartridges prevent this command from being entered. I would appreciate it if someone could come up with a permanent fix for this. Is Commodore working out a solution?

David St. Romain

Several readers have mentioned this problem. It appears that some recent Zeniths (and reportedly some Sylvania sets, too) get a bad case of the "flutters" when attached to computers. The culprit is evidently a new circuit in some televisions which are "auto-setting." And the problem isn't limited to VIC — any computer can create these unpleasant effects with these models. Aside of the POKE solution you mention, Zenith has sent a technical notice out to its service centers with instructions on curing the problem. It involves a simple disconnection of a yellow wire and your local authorized Zenith center should be able to perform the modification.

The most recent VIC cartridge games and other recent programs released by Commodore have an "interlace mode toggle" built in. Pressing the F8 key will switch back and forth between the two screen modes and you can see which setting produces the best results on your set. Programs with model numbers between 1901 and 1908 do not have this toggle feature, but most of the later programs do.

August 1982, Issue 27

Fuzzy VIC TV Picture

I am getting a poor TV picture when the VIC-20 is hooked up and activated. I believe it is RF interference. Is there any way to eliminate this so that I can obtain a clearer picture?

D. Murphy

Early VICs caused severe interference problems, a feature which Commodore has made efforts to correct. For more information on solving your particular problem, call Commodore's technical assistance hotline, (215) 687-4311.

February 1983

The Commodore VIC-20, introduced in 1980, was Commodore's first computer without a built-in monitor, and one of the first to be marketed as being connectable to a standard television set, along with the Atari 400, Tandy Color Computer, and the Sinclair ZX81.

Due to US Federal Communications Commission rules at the time which stipulated strict shielding requirements on any equipment emitting radio frequencies in the licensed TV spectrum, Commodore included an external RF modulator instead of putting the circuitry inside the computer.

While this helped to reduce the overall cost of the VIC-20, the signal generated by early versions of the modulator was quite weak (and even later versions were still quite weak compared with competitors) the modulators were mistuned, and as a result some televisions couldn't even recognise the sync pulses the modulators emitted, resulting in an unstable image.

Fine Tuning The VIC's Audio And Video

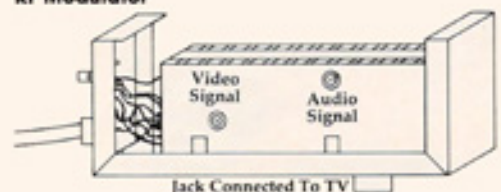
For those who might be having trouble with the picture and sound on their VIC-20, I have a solution.

It is essential that the sound and picture be adjusted properly in the RF modulator so that they are synchronized on either Channel 3 or 4. The computer is sold with the audio and video signals adjusted for one particular TV model. This may not work well on yours.

To make adjustments for your TV, carefully follow these steps:

1. Turn the computer off and the TV on.
2. Turn off the AFT (Automatic Fine Tuning) switch on the TV (if your set has one).
3. Adjust the fine tuning knob on the TV to the middle range of that channel. Don't worry if the picture is partly fading or the sound is distorted at this point.
4. Open the RF modulator very slowly and carefully. Be sure your power is off. Remove the casing screw and slowly lift the cover.
5. Turn on your power for the computer.
6. There are two holes which have screws in the metal casing. The one closest to the channel selector switch is the video signal. The other is for audio (see figure). Using only a small nonmetallic picture is crisp and sharp. This acts like another fine tuning knob. Check the other channel and make sure it is in the middle of the RF signal range by adjusting the fine tuning knob on your TV.
7. Adjust your TV volume to about one-half. Now adjust the audio signal level in the RF modulator until a quiet, clear sound is heard on the TV.
8. Make sure that, on the other channel, both audio and video signals are perfectly adjusted.
9. Turn the computer off and replace the cover on the RF modulator.

RF Modulator



Mark Kormendy

We tried your suggestions and they work very well indeed. However, we do not advocate hardware modifications except when performed by qualified, experienced technicians. Readers should be extremely careful when making internal adjustments on any electrical component. Also, tampering with the RF modulator will void your warranty. (Later versions of the VIC RF modulator may not have the adjustment screws.)

We tested this also on the internal RF modulator in the 64 but found no appreciable difference in screen or audio quality. If we hear of anything significant on this, we'll publish it in a future issue.

October 1983

paleotronic

LETTER OFFICE

the TV. . .

commodore 64

The New Wave Of Personal Computers
An In-Depth Look At The New Commodore 64, Sinclair Color Spectrum, Epson Portable Computer, And More

COMPUTE!

The Journal For Progressive Computing

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This month's dead letters come from Compute! magazine issues dated 1982/1983.

The VIC-20 wasn't to be Commodore's only computer with video problems – the Commodore 64, released in 1982 also had its share of issues. By this time the FCC had relaxed its requirements and the 64's RF modulator was included inside the computer, but its signal strength still wasn't great, and even the most casual of RF interference would make for a very wavy computing experience!

64 Screen Problems

I own a Commodore 64 computer. While I am quite pleased with its performance, there is a problem. Any program that uses the BASIC commands GET or INPUT causes severe interference in the form of many white (silver) horizontal lines which shoot across the color TV screen.

I also purchased some software (namely *The Word Machine* and *The Name Game*) from Commodore and these programs exhibit that same, quite annoying, problem. I might add that three friends here in Albany who also own the C-64 have the exact same problem. I have heard that Commodore replaced a video chip in the later models (of which mine is one) and that there are problems with this new chip.

My question is: will Commodore solve what may be a very large (in number of computers) problem? My warranty is close to expiration.

July 1983

Donald G. Weiser

This is probably the question we're asked most about the Commodore 64. The problem that you are referring to has come to be known as "sparkle."

The problem starts with the 64's character ROM, and the sparkle is caused by the way the 64 generates its characters to put onto the screen.

However, this problem can be more than a mere inconvenience in the early machines. It can cause difficulties with some programs, especially games. When utilizing the advanced 64 Sprite features (user defined, moveable objects), the sparkles can cause the computer to register a sprite collision when none has occurred.

There are some solutions. One is to make a few hardware modifications inside the 64, but this solution is frowned upon by Commodore, and may void your warranty. Another is screen relocation. It is said that if you relocate the screen memory into another area of RAM, the sparkle will disappear.

As for the number of units plagued by this problem, Commodore's estimate is five percent. It should be noted though, that almost all of the early models had sparkle, and as of this writing the problem is apparently still not solved. As a matter of fact, **COMPUTE!** recently purchased two 64s for testing purposes, and one has a very severe "sparkle" problem.

In answer to your question on repairs, Commodore has no set policy in this area. For units that are under warranty, Commodore says that it will attempt to repair anything with which the customer is dissatisfied.

Concerning units out of warranty, Commodore had no comment. However, a number of computer dealers and repair centers have stated that they will install the new or updated character ROMs if they can get them from Commodore. Commodore has said that they have not yet decided whether or not they will make the new character ROMs available to the service centers.

But that wasn't all. In some early units, video distortions or "artifacts" could appear while software was running, and even cause some games to misinterpret the distortions as sprite objects, registering collisions and "killing" players!

These days, companies which release products with such defects will recall them or extend their warranties to cover the issue, but not in the 1980s and not Commodore. Unless the customer raised a real ruckus, Commodore otherwise pretended the issue didn't exist.

A cathode-ray tube uses electromagnets to direct the streams of the electron guns inside it. Depending on how shielded the TV is that contains it, the electromagnetic field generated during operation can extend outside the TV's cabinet.

This field can interfere with the operation of VCRs, cassette players and floppy drives, and even erase tapes and disks!

64 Video Glitches

I'm disappointed with the quality of the Commodore 64 video display. For example, when selecting black characters on a blue background, every other character is badly smeared. Also, when executing a program, small "birdies" appear randomly all over the screen. These are about one pixel in height, three to eight pixels in width, and appear in the same color as the characters.

Is there a fix for these problems? September 1983

Some colors don't seem to work well together on the Commodore 64; you might try combinations of foreground and background colors to see what works best on your machine.

If you are using a TV set, look for solid connections (try wiggling things gently) and make sure your TV/COMPUTER slide switch is firmly over to the COMPUTER side. Try rearranging the cable which connects the computer to the TV set: sometimes interference is picked up along the way. Even moving the computer can often help.

On the other hand, if you are using a monitor rather than a TV set, there are other things for you to keep in mind. Commodore will soon be announcing a new interface – and a new monitor – that should significantly improve picture quality. Still on the subject of monitor interfaces, some users find that they can get better character definition by a variation in the wiring of the interface. Normally, pin 4 of the video connector is used for video out on the Commodore 64; some users like the improved contrast that may be achieved by connecting pin 1 (luminance) to pin 4 and then feeding the composite signal to their monitor.

We understand that the screen hash that you call "birdies" can be eliminated completely by the addition of a small capacitor to the video circuitry of the Commodore 64. Contact your dealer for further information.

A VIC Taping Mystery Solved

I only had my VIC-20 for a short time when I started having a problem: programs didn't load, or came up "out of memory", or loaded garbage graphics. I had purchased a new Toshiba black stripe 14" color TV to go with the computer and only experienced the loading problem with the new TV; everything worked perfectly when hooked up to my eight-year-old Electrohome TV.

With excellent assistance from my dealer – Compupro Micro Systems, Welland – I tried to isolate the problem. I changed wiring, computers, recorders, had the TV tested, but the problem persisted. After much frustration I hit upon the solution by accident.

My problem disappeared when I reversed the position of the computer/recorder and TV! Instead of having the TV to the left of the computer/recorder combination, I moved it to the right.

You might think this is crazy, and to this day I am at a loss to explain why this worked. All I know is that I no longer have any loading problems, but if I reverse the components my problem returns!

November 1982, Issue 30

Foster J. Zanutto



because you don't know
if you're talking to a dog
(or cat) on the Internet...

FidoMail

Members of the Apple II Enthusiasts group on Facebook recently speculated about the image to the right, part of an early Apple II magazine advertisement...

Some were concerned about the poor ergonomics demonstrated by the computer and monitor placement:

Madeleine M: How about set it up in the store so the poor kid can actually see the screen. That's how I'd buy one. Sitting in front of it...

Julia Z: That's certainly not how to use one. Like...that monitor isn't connected to the computer. Lol

Adam M: technically, it could be, just a really long wire/cable

Jorma H: That's a cool monitor!

Lisa A: It's a Sony! ;-) Sony KV-1722 :-)

Gordon A: Ergonomics Fail

Daniel D: The first thing that screams out to me about this ad... the monitor being 5 feet away from the computer, and tilted away so one could guarantee a stiff neck after 10 minutes of usage.

Paul W: How NOT to set up a computer work station. Marketing people are usually rather clueless.

John L: That was the 1970s. People didn't know about "ergonomics" back then. Workstation setups like the one depicted in the advert were pretty typical, and is what lead to the ergonomic revolution of the late 1980s. Of course, by then, the damage had already been done.

Matt R: Seriously, can someone move that Apple closer to that poor kid.

Others speculated on the motivations of the salesman:

Michael S: Wth is Don Draper doing to that little boy and why is the Mum not stopping him?!

Dyfed H: "Get out of the store kid, you know you can't afford one."

Lee P: I resemble that remark.

FidoMail was an early networked e-mail protocol that allowed users of FidoMail-enabled bulletin board systems to message each other. Back when you didn't know if the entity you were talking to was a human or a dog.

Our "letters to the editor" section, FidoMail is more likely to contain Facebook comments and Reddit posts than actual direct letters, but if you want to send one in, you can mail them to editor@paleotronic.com



For some, it brought back memories of when they first encountered an Apple II:

Robert M: I remember when we bought our first computer, an Apple II+ back around 1980-81. It was a lot of money. We bought the Apple II with 2 drives, not 1 and a bunch of extra things to go with it. First my mom and I went to Computer Land to get info and help since we knew nothing about computers at the time. They weren't very friendly to us and all they did was give us a price list of all the Apple hardware available at the time and point us to a book shelf and tell us to buy this and this book, etc. We ended with about \$50 worth of books about subjects we knew nothing about. Finally some weeks later we pulled the trigger and bought at a office supply store in Redwood City. Today over 30 years later I still have it.

Gordon A: Mine came from a ham radio shop in South Carolina in 1979. We and one other person got the first two][Plus units sent to the shop. The other guy was more interested in collecting so we agreed he would get the converted II with the ram jumper blocks and we got the newer model. I actually did pay for 1/2 of mine with paper route money. I had been saving \$100 a month. The newspaper didn't normally allow 11 year olds to deliver papers so I kept the route in my older brother's name until I turned 12. The guy who took the route from me was the LAST bicycle paper boy for the entire distribution of that paper.

Ken C: my first job in the 1980s was in one of these shops working on Apple IIs.

And some were curious about the background:

David W: Why is the background "Computer" title reversed on the image (although the two Apple logos left to it are shown correctly) ?

Joe E: It looks like a whited out window

Jeremy D: They did that to make it look like a window in a computer store but didn't want you to see outside.

What was your first trip to a computer store like? Did you get kicked out? Tell us about it!

interesting DEVELOPMENTS

retro-related open-source applications and utilities



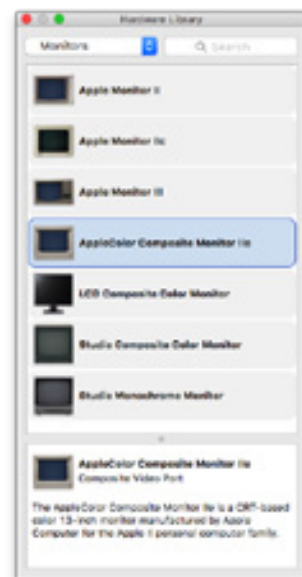
Open Emulator

github.com/OpenEmulatorProject/

OpenEmulator is an open-source emulation project that aspires to emulate a number of 8-bit computer systems. It currently emulates several models of Apple I and II computers, and provides a framework for further emulation of others.

It is notable in the context of this issue for providing comprehensive CRT monitor emulation. Several pre-configured monitor templates are offered, along with many tweakable parameters such as shadow masking, scanlines, phosphor persistence, video bandwidth, colourspace, and typical monitor controls like hue, tint, saturation, brightness and contrast.

There is currently a MacOS version available, and Windows and Linux versions are in progress.



Applesauce

evolutioninteractive.com/applesauce/

Applesauce is a hardware and software solution intended for accurate preservation of Apple II disk images in such a way that even copy-protected disks can be run in an emulator.

As part of this, a new emulator file type has been created. The **.WOZ** format more accurately represents the way data is actually encoded on an Apple II diskette, as a bitstream that is also the exact length of a track. It also contains a track map, which better allows emulators to read many copy-protected disks.

When Steve Wozniak designed the Disk II system, he decided the track synchronisation sensor common in contemporary floppy drives was irrelevant, and so he threw it away. Since the locations of the sectors were specified in a table at the start of the disk, hardware synchronisation wasn't needed. However, commercial software companies could produce Apple II-compatible disks that were hardware synchronised, then have their software manually jump to a specific physical location on the disk and read the data there. If the data was incorrect, the program would halt.

By including a track map, the **.WOZ** file format reproduces the synchronised nature of some commercial diskettes, making it easier for emulators to behave correctly. 🐉



.pak files

how to breath new life into old games

.pak is a new file format used in microM8 to contain configuration files and assets used in the “upcycling” of classic games. For example, in the “pak” version of Montezuma’s Revenge (right), we’ve placed a brick background behind the action. Configuration files specify colour remapping and voxel depth information, and a control program runs in a parallel Applesoft BASIC interpreter, keeping track of the joystick position and rotating the camera around the 3D model appropriately. All of these combine together to create a unique and new experience. .pak files bundle all of these files together in a compressed format, to allow for portability and ease of use.



You can create your own .pak files by navigating (in the microM8 catalog) to the disk, binary or BASIC program you wish to be the primary executable in the new .pak, and pressing control-shift-P. The new microPak is created in your /local directory (or root directory, if logged in to microLink). A predefined set of configuration files is automatically generated inside the .pak, and you can copy your desired asset and control programs into it. To boot it, you just select the .pak.



Using the catalog, you can navigate inside your new .pak by pressing control-shift-O while the pak is highlighted. You can edit the configuration files by highlighting your selection and pressing control-shift-E. Then press control-shift-O inside the editor to save.

There are several example microPaks to explore inside the /micropak folder in the root of the catalog.

Did you know that you can “print” PDFs from The Print Shop and other classic printing programs? Configure the application to use an Epson printer connected to a parallel-interface card in slot 1. microM8 also supports 4-colour printing! The PDF is generated around thirty seconds after the application has finished “printing”. It will be located in the ~/microm8/myPrints folder below your home folder.

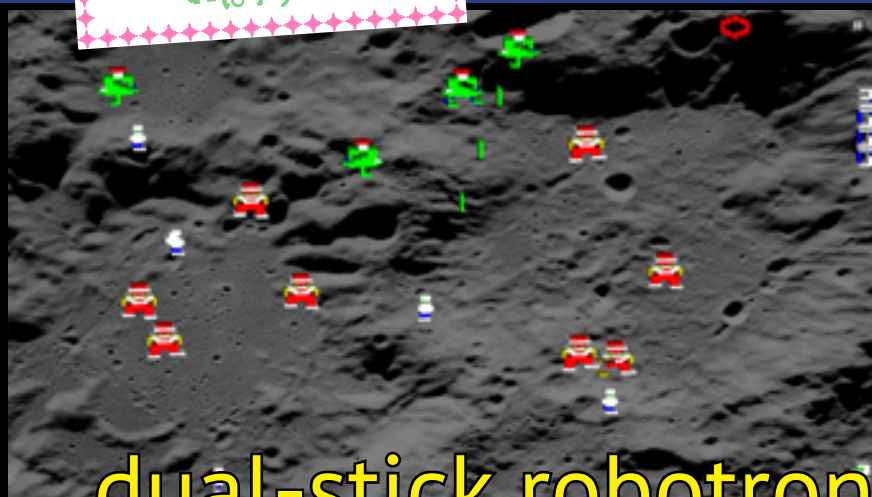


Do you feel nostalgic for the days of Bulletin-board systems (or BBSes?) Well, pine no more! There are hundreds of BBSes currently in operation – but rather than dial them with a modem, these days you connect to them over Telnet, an Internet protocol.

It's not quite the same experience though, since Telnet clients are modern. However, we've introduced a new feature into microM8 called a “virtual modem”. It interfaces vintage terminal programs (such as ProTerm) with the Internet, so that you can visit today's BBSes like people did in the 1980s!

The latest version of microM8 includes a direct link to ProTerm off of the main menu. Once ProTerm opens, you will see a few instructions describing how to browse the built-in BBS list, and connect to your desired system.

A word of warning – as in the “old days”, some of these BBSes contain mature content...



The arcade version of Robotron 2084 was played with two joysticks – one to control movement, and the other to control firing direction. However, those who “ported” the game to home computers felt that their players would only use a single joystick and coded those conversions accordingly.

But now, we live in an age of dual-thumbstick gamepads, and it only makes sense that you ought to be able to play Robotron the way it was originally meant to. Happily Nick Westgate patched Robotron to support two joysticks, and microM8 now supports dual-thumbstick gamepads! You can find the enhanced version in the micropaks directory, or the clean .DSK in disk images under R.

dual-stick robotron

paleotronic microM8

the sweet sound of music...

The Apple II had excellent graphics for its time, but very poor sound. This oversight, however, was remedied by a number of add-on cards based around the AY-3-8910 sound chip, such as the Mockingboard.

We've now added Mockingboard support to microM8, but it was a bit tricky.

You can record Mockingboard music in microM8, and then use it as background music in your microPak games! Press Control-Shift-R, release then press A to start recording. Press C-S-R then Space to stop. You will find the recording in /local/myAudio. Copy it into your .pak and modify the audio.cfg file appropriately.

update

TIMEWARP

We've all been frustrated by levels in games we couldn't get past. You make it all the way to the end just to die repeatedly, until you run out of lives.

Other emulators allow you to save memory snapshots, and microM8 does that too – but what microM8 can do in addition makes beating those tough games simple.

microM8 has a feature we call “live rewind”. Once your game has started, you can turn on live rewind by pressing Control-Shift-R, release those keys, then quickly press W. You will hear a sound confirming the second keypress. Once live rewind is turned on, you can “rewind” the action by pressing Control-Shift-[(open angle bracket). If you rewind too far, you can move forward in the recording by using Control-Shift-].

Once you've progressed back past your death to somewhere safe, you press the spacebar to return to play, and then try, try again...

BBC Micro support coming...


We've spent a great deal of effort trying to polish the Apple II and make it as shiny as it can be, but microM8 was designed to be a multi-system emulator, and the time has come to move on and implement a second computer architecture. We've chosen the BBC Micro due to its exceptional BASIC and large software library, and see it as a natural progression in emulation between the Apple II and systems such as the Atari 800 and Commodore 64, which will come later.

Most emulators work by running everything through a single “loop”. This makes sound emulation easy because everything is synchronised. However, microM8 doesn't operate this way. Each component of microM8 (video, sound, CPU) functions on its own, communicating with each other the way a real computer system does. However, because microM8 is a software program and not hardware, there is latency – and this causes serious problems for sound emulation.

So, while emulating an AY-3-8910 is practical for other emulators, it wasn't practical in microM8. So instead, microM8 has its own synthesiser, which understands the same commands as the AY-3-8910 and generates similar-sounding output. This provides higher-quality sound and additional mixing options.

The Mockingboard was an add-on card for the Apple II. It provided four-channel sound support, which was important as the Apple II only had a two-bit speaker only really useful for simple bleeps and bloops (although some game developers really tried their best!)



However, the Mockingboard wasn't as successful as you might have expected, and only a small number of games actually used it. But most music software supported it, and that is useful to us. 

mockingboard support

Yesterday's News

LATEST FROM THE RETRO NEWSWIRE



THE OREGON TRAIL HANDHELD GAME

American retailer Target surprised many recently by releasing a handheld Oregon Trail game which appears to be an emulation of the 1990 DOS version created by the Minnesota Educational Computing Consortium (MECC). We at Paleotronic have obtained our own unit, which we will be reviewing in a later issue.

Originally developed as a mainframe program way back in 1971, The Oregon Trail was designed to teach schoolkids about 19th-century pioneer life. The player takes the role of a wagon leader guiding a party of settlers from Independence, Missouri to Oregon's Willamette Valley in 1848.

Members of the party can die in a number of ways, such as measles, snakebite, exhaustion, typhoid, cholera, drowning, accidental gunshot wounds and most famously, dysentery. Players hunt for food and make decisions regarding the journey, including when and how to cross rivers, or deal with random interactions with strangers.

The game was so popular in North American schools during the 1980s that people raised during that period are sometimes called the "Oregon Trail Generation"!

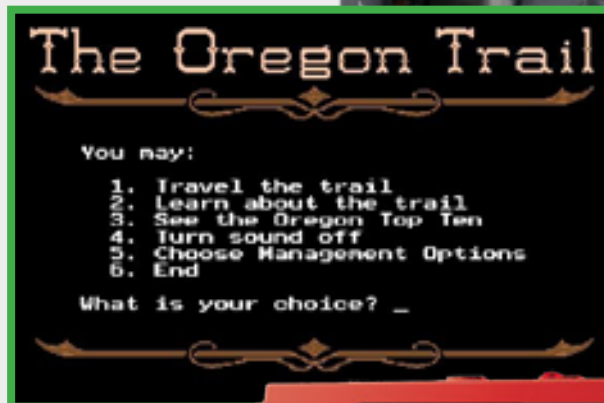


Photo by
Bill Loguidice

The unit appears to emulate the MS-DOS version of Oregon Trail.

DATA EAST CLASSICS PIXEL PLAYER

First released a year ago, retailers seem to be dumping this retro-handheld console, so if you're interested you might want to grab one soon! The Pixel Player comes in two formats, a Game Gear style like the one pictured here, and a Game Boy style that (for some reason) sells for a few dollars more. Each of them contains 8 classic 1980s Data East games including Bad Dudes, Burgertime, Joe and Mac Caveman Ninja and Karate Champ. It also has 300 additional "generic" NES games containing a few hidden gems such as NES Pinball.



The Pixel Player features a cool pixelated design. It's definitely nicer looking than some of the other Chinese handhelds we've seen. It's also red!

We've seen several Chinese NES-based handhelds over the last few years with dodgy emulations of many popular games – namely Super Mario of various incarnations – but this is the first one we've seen with legitimately licensed titles. Hopefully the Pixel Player isn't also the last. Maybe Nintendo can be persuaded to release a Game Boy Classic Edition?

Retro-compatible hardware manufacturer Hyperkin, meanwhile, announced at CES 2018 that it was coming out with a Game Boy clone, but it will require the player to have their own vintage cartridges.



The "Ultra Game Boy" is expected later this year for around \$US100.





The Vega+ purports to contain 1,000 licensed ZX Spectrum games, and has an SD card slot for loading others.

You can also plug it into a TV.

Its Indiegogo crowdfunding campaign was wildly successful, but after two years it still hasn't shipped.

ZX SPECTRUM VEGA+ CONTROVERSY

Will it ship or won't it? That question hasn't yet been answered, but it's not looking good. After releasing the ZX Spectrum Vega, a plug-and-play TV game containing emulated ZX Spectrum games in 2015, Retro Computers Ltd. launched a successful crowdfunding campaign for a handheld version, dubbed the Vega+. However, after first promising a release in September 2016, the date kept getting pushed back and eventually (according to the BBC) crowdfunding site Indiegogo issued an ultimatum: ship by the end of May this year or else!

Retro Computers has since claimed they're shipping the Vega+ on the 8th of May, but we're not holding our breath. Shame though, looks awesome!

RETRO 77 VS ATARIBOX "VCS"

Hyperkin insists the Retron 77 is still coming. Announced at E3 2017, the 720p resolution Atari 2600-compatible addition to Hyperkin's Retron line of retrogaming consoles has so far been vapourware. We wonder if the delay is because of the "Ataribox" – now rebranded as the VCS. Announced by France-based Atari SA (formerly Infogrames), the VCS is based on the Linux operating system, and will be able to run classic Atari titles sold through a storefront application, as well as newer software titles.



Vapourware?
We hope not!
C'mon Hyperkin!
YOU CAN DO IT!

Apparently, an Indiegogo crowdfunding campaign for the VCS is being launched at the end of May – not like that hasn't worked out before...

As for the Retron 77, perhaps its issues are unrelated. We imagine several ways providing compatibility with real Atari 2600 cartridges might be difficult. In any case, we want one, and so we're crossing our fingers Hyperkin will come through. Once we have our hands on one, we'll be sure to review it!

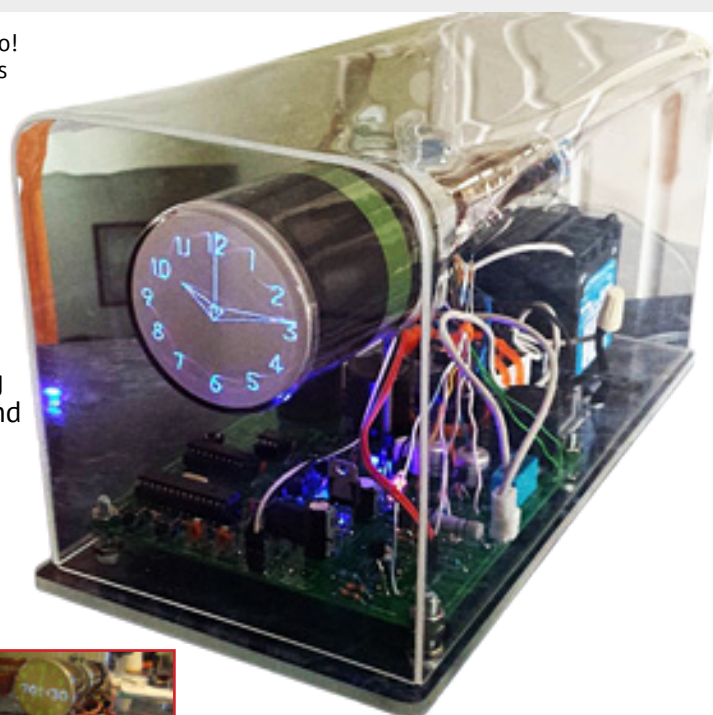


Cool joystick, bro!
But Hyperkin's is cooler!

Keeping in the theme of this month's issue, this cathode-ray tube-based clock is a really cool piece of kit!

This model, available for US\$350 on maker web-store Tindie, features a blue phosphor CRT. Individually handmade by Oscilloscope Clocks of Finksburg, USA it works on both 120 and 240VAC, and contains controls for adjusting the height/width, brightness and centering of the clock. It also automatically moves the clock around slightly to prevent burn-in, which can happen when the same phosphors are energised for too long (and is why screensavers were invented!)

Oscilloscope Clocks has several models of clocks, you can see them all on their website at oscilloscopeclocknixiecr.com



CRT CLOCK



Sinclair Spectrum Designer Rick Dickinson Has Died

Some sad news from the computing history world. British designer Rick Dickinson, responsible for the unique case and keyboard of the Sinclair ZX80, ZX81 and Spectrum computers, has died in the US while receiving treatment for cancer. He will be sincerely missed.

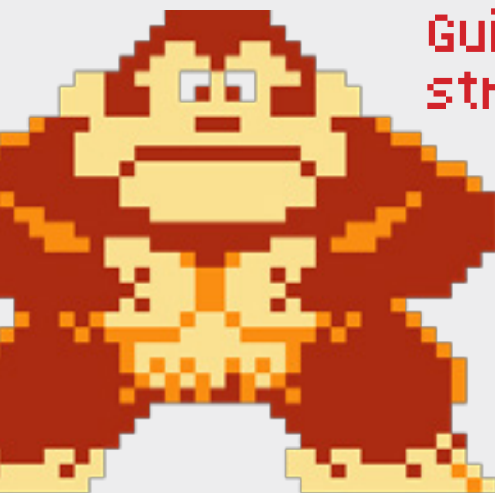
Dickinson was tasked with finding a minimalist design that could keep manufacturing costs down while remaining practically functional. The touch sensitive keyboard used in the ZX80 / 81 was pivotal to reaching Sinclair's low prices, which made computing obtainable for thousands of 1980s youth. Thanks Rick.



Call-A.P.P.L.E. celebrates its 40th anniversary...

Huge congratulations to Apple II community behemoth Call-A.P.P.L.E. on its 40th anniversary. The monthly journal publication of Seattle-based user group Apple Pugetsound Program Library Exchange was published from 1978 to 1990, then went on hiatus before resuming in 2002 and it has been publishing ever since. Call-A.P.P.L.E. covers both vintage and new Apple products, as well as emulation.

For a limited time, the 40th Anniversary Issue is free to download at callapple.org



Guinness Book of Records strikes out Billy Mitchell

According to Guinness it's official – Billy Mitchell cheated. The King of Kong star has been caught out using an emulator – a huge no-no in the retro-gaming competition circuit. Arcade score-keeper Twin Galaxies has also removed Mitchell's records for Donkey Kong and Pac-Man from its leaderboards.

Mitchell, of course, claims that he didn't cheat, and that he can prove it. But that remains to be seen...



Nintendo's Donkey Kong has always been the subject of intense competition amongst arcade gamers. The 2007 documentary *The King of Kong: A Fistful of Quarters* covered Mitchell's intense rivalry with Steve Wiebe, a Seattle engineer.



Press the button to release the chains and drop onto the track but make sure you're over it!

Stunt Car Racer Atari 130XE Port

Popular C64 and Atari ST game Stunt Car Racer (known as Stunt Track Racer in North America) has come to the Atari 8-bit computer line. Known for its fast action and ridiculous simulated heights, the 1989 game was ported from the Commodore 64 by Czech retro-coders Fandal and Irgendwer. A disk image of the game can be downloaded from a8.fandal.cz/detail.php?files_id=7541



Reaching the ground after leaving the track can take some time. Drop far enough and you'll bounce. Ouch!

µCassette + tapDancer

Get a LOAD of that tape!

Loading tape games on a C64 can be a hassle. Assuming you can find a working datasette for the system, the chances are that a lot of tapes have degraded to the point of being unusable, particularly in the heat of Australia.

A lot of these games have been preserved online by people as tape images, but loading them onto an original machine can be tricky.

A number of years ago, we actually wrote an Android app called TapDancer, which aimed to provide an audio signal generated from these files which could then be fed into a datasette, by using a car cassette to CD adapter. This worked, but it depended a lot on the head alignment of the datasette, the adapter and a number of other factors. When it worked, it worked and when it didn't it didn't.

In comes the uCassette. It removes the need for an adapter and datasette by providing the bridge between the C64 cassette port and the analogue signal output by TapDancer. It does this by converting the incoming audio signal to the digital signals that the datasette would normally output.

The device comes quite professionally packaged, with a manual, and a DVD containing some 500 audio files that can be fed to the device, as well as a 3.5mm to 3.5mm cable that can be used to either connect an audio player, or connect your Android phone. The unit itself is well constructed with a beautiful case in the datasette beige, with a silver and black label. It is very in-keeping with the C64 aesthetic.

Overall: 9/10

tapDancer is an Android application that converts archived datatape files back into audio so that they can be loaded on vintage computer systems. It supports the C64, Sinclair Spectrum, Acorn Electron, Atari 8-bit and MSX platforms.



To use the device, one simply plugs it in, and turns the computer on, then presses either SHIFT-Run/Stop or Commodore-Run/Stop keys. This tells the C64 to start searching the tape. Press play on your player or android device, and then the system should behave as if it has a real tape player attached.

It works much more reliably than the Datasette + CD Cassette adaptor method. The only thing you may need to adjust is the output volume of the device supplying the audio signal. For folks that just want to load games, and also enjoy the classic loading music and graphics it is a worthy addition to their systems.

Pros

- Much more reliable than using a CD cassette adaptor with a real datasette.
- Very nicely packaged
- Listen to real loading music

Cons

- Real tape loading times ;-)



RETRO REVIEWS

WHAT'S NEW WITH WHAT'S OLD

COMMODORE 64

SD2IEC

Because Commodore disk drives suck!

So, if loading off tape isn't your cup of tea, you might prefer to use disk games. Unfortunately a lot of the disks are degrading to the point where they flake metal oxide onto your drive heads meaning the drive can be damaged.

A modern solution to dealing with disk games is the SD2IEC. This is a device that plugs into your C64 via the disk drive serial port and emulates a 1541 Disk drive. The device uses disk images (D64/G64) to emulate the drive, storing them and its own programs and firmware on an SD card. It supports writing to the disk images as well, so it really does work as a drop in replacement for the 1541. In every respect, the SD2IEC behaves like a regular 1541 disk drive.

The device requires some setup. One needs to first find a blank SD card (an 8GB card worked fine for us), and format it with a FAT filesystem. One needs to download the firmware for the device and copy it to the SD card. This includes file browsers written for a number of platforms which support the drive, including the VIC 20, and Plus 4 systems.

Some versions of the Sd2IEC require a 5V power supply, but the one we tested was designed so that one end of it plugged into the cassette port to get the needed voltage there.

It is recommended to use a folder structure to organise your disks according to the creators of the device, and it makes sense too, as the file browser runs on the C64 itself and due to limits of memory, you don't want to give the machine too much to deal with at once.



Running the file browser is as simple as loading it off the SD2IEC with a command:-

LOAD "FB", 8, 1
RUN

The device can treat any SD card directory as a disk itself, too so it is possible to load a "PRG" file directly off the SD2IEC for games that are a single load. In testing, the device worked reliably, and is a great space saver if you don't miss the real 1541 disk drive sounds. We only experienced one instance where it caused file corruption on the SD, but that was our fault for power cycling the machine while the SD2IEC was active.

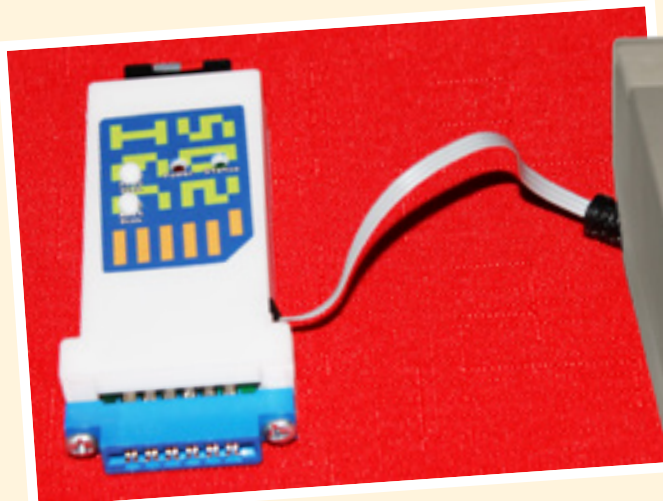
Pros

- Can store a huge number of disks on an SD card.
- Works just like a real 1541 drive.
- Works with any system that can use a 1541.

Cons

- Some manual setup required (firmware files)
- Speed of a real disk drive due to the serial connection.
- Can leave corrupt files if power cycling the machine while active.

Overall: 7/10



ACCESSORIES

Classic Games 4-Player Interface

Let's have a
M.U.L.E. party!



Gaming is more fun when it is shared, and although the C64 has two joystick ports, there are times when even two players isn't enough. In that situation, the 4 Player interface comes to the rescue, providing an extra two 9 pin joystick connectors to the C64.

The interface plugs into the User Port on the C64, and then provided the software supports it, it is possible to read a second pair of joysticks. It's a very easy way to get more people in on games that support it, provided you can find enough working joysticks!

So, what titles are supported by the 4 Player interface? Currently there are about 20 titles available, some new games, some remakes of classic multiplayer games from other platforms (bomberman anyone?), and some are "hacks" when someone has patched the game code of an existing C64 title that allowed multiple players to allow up to 4 simultaneous players..

A worthy mention is the classic game M.U.L.E. which always supported 4 players with 2 of them being computer players in the original. It has been updated so that 4 joysticks can be used. Get mining that Smithore!

There is also a modified version of IK+ called IK+ Gold edition which allows 3 players at a time.

A new title, released in 2017 called Frogs allows up to four players to compete as frogs either trying to collect the most bugs, or by pushing each other into the pond. It's a lot of fun.

Pros

- Allows 4 Players to compete together - great fun at a party
- Plug and play

Cons

- Only limited support, requires adding 4 Player support to games.

Overall: 8/10



Set on the fictional planet Irata (Atari backwards), M.U.L.E. is a four player strategy game based on supply and demand economics. Each colonist is progressively allocated plots of land, which they then "cultivate" by installing specialised Multiple Use Labour Elements, each of which generates food, captures solar energy, or mines for Smithore (a metal used for constructing MULEs) or Crystite. Players short on food have their turn times restricted, those short on energy find their MULEs' production limited. Food, energy, Smithore and Crystite can be bought and sold at auction between turns, and the player that has the highest net worth at the end of a set number of turns wins.



Welcome to the
Australian Pinball Museum

See motel reception if unatt
or machines are switched

Located in the small town of Nhll, Victoria, on the highway half-way between Adelaide and Melbourne, is this surprising pinball museum.

Located in one of the many motels that line the main street of the town, the Australian Pinball Museum houses the largest selection of both vintage and new pinball machines available to play in Australia. Over eighty years of pinball history are covered by a variety of machines, from Bally's 1932 game "Screwly" to Guardians of the Galaxy (2018). Every decade from the 1960s onwards is well represented by the 32 machines. The museum has a number of additional machines in storage, and rotates them over time.

Current games include:

- Aerosmith Pro (Stern 2017)
- Banzai Run (Williams 1988)
- Cabaret (Williams 1968)
- Champ (Bally 1974)
- College Queens (Gottlieb 1969)
- Devil Riders (Zaccaria 1984)
- Dracula (Williams 1993)
- Fashion Show (Gottlieb 1962)
- Fire! (Williams 1987)
- Fish Tales (Williams 1992)
- Gold Wings (Gottlieb 1986)
- Judge Dredd (Bally 1993)
- Kiss (Bally 1979)

...and many, many more. The museum also maintains an archive of various pinball-related print media including magazines, promotional flyers, posters, distributor price lists, and service manuals and bulletins.

The museum is open every day from 11am to 9pm. The games cost between \$1 and \$2 per play. The museum also has occasional "free play" events and competitions.

For more information or to get directions, check out the museum's website at:

www.pinballmuseum.com.au

ON THE
ROAD





In On The Road, Paleotronic explores retro-technology related arcades and museums.



Revenge from Mars was designed by George Gomez with artwork by John Yousi and Greg Freres.

Video Games meet Pinball...

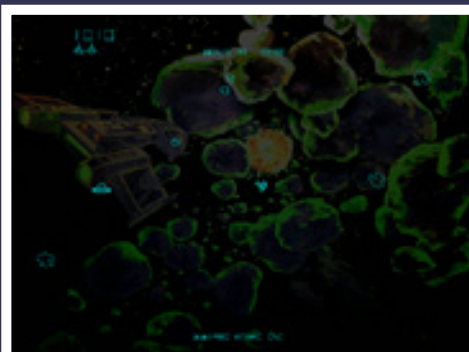
Revenge from Mars was the last game released under the historic Bally Midway name, in 1999. It used parent company Williams' "Pinball 2000" system, which overlays interactive video on to the mechanical playfield.

The system relies on an old amusement-park illusion known as "**Pepper's Ghost**". In the trick, there are two rooms, one a mirror image of the other. The audience can see into one of the rooms, which has a floor-to-ceiling piece of glass angled in the centre of it such that it can reflect light from the second, hidden room. By turning up or down the lighting in the second room, one can manipulate the intensity of the images reflected off the glass, and the audience sees this as ghostly apparitions fading in and out. This technique is used in Disneyland's Haunted Mansion attraction.

In the case of **Revenge from Mars**, a CRT is housed in the marquee which projects down on to a reflective piece of transparent plastic, allowing for the upper area of the pinball playfield to have dynamic graphics.

While the bumpers and spinners do not change, the graphical context they appear in does. For example, one minigame has the player battling flying saucers as they attempt to abduct various objects, including sportscars and cows. Another portrays a Martian tavern, where various drunken aliens crack human jokes and drink flammable substances. The pinball is used to affect or destroy various items in the scene.

Revenge from Mars sold nearly 7,000 units, and the future of the concept appeared promising. However, the second game produced using the system, **Star Wars Episode I**, was rushed and flopped, selling only half as many units and prompting Williams to exit the pinball business entirely.



The **Revenge from Mars** machine at the Australian Pinball Museum in Nhill, Victoria. We had a great time playing it!

The Williams 2000 system was inspired by the 1980 Atari videogame **Asteroids Deluxe**. This vector-graphics game used a one-way mirror to reflect background game art.



ATTACK OF THE CLONES PART II

Recently we reviewed the AtGames Sega Mega-drive Classic, and it wasn't fantastic so I thought I'd give another clone system a chance to see if it could make up for the failings of the AtGames device.



The "FEO HAO Retro Game HD" looks for the most part identical in form factor to the Genesis Mk I, with the difference being that it has RCA out for video and audio, as well as an HDMI port for video. For a lot of people, being able to hook up the unit directly to a modern TV will be a plus, but it still has connectors for the purist who wants to play it on a CRT as well.

In the box, it came with 3 controllers. Two were wireless controllers, and one was an actual Genesis compatible controller. Just like the original, there are two controller ports on the front, so you can use classic controllers with this if you would prefer. Also in the box, were AV cables (composite and HDMI), and

a power adaptor (North American plug) so you may need a plug converter if you aren't in that region. We had an Australia/NZ plug adapter handy and it worked just fine with it.

Sound quality is surprisingly good for a clone system, in part due to this being based on GOAC (Genesis On A Chip), unlike the AtGames which is actually just an emulator. Audio appears to be a mono mix, but is such a good quality that we were not too bothered by this. One thing that was a little disappointing was that we could not get the headphones jack to work. It appears to be wired up, but could have been an issue with our unit.



This clone comes with two six-button wireless controllers and one wired one, which features a screw-in mini joystick. It purports to have compatibility with original Genesis controllers.



Video output was surprisingly clear on both CRT and HDMI. Colors were vibrant and there didn't seem to be any issues with frame rates or slowdowns.

On the back of the unit there is a switch to switch between USA and JAPAN compatibility but no option for PAL. PAL support is hit and miss and depends on whether the cartridge enforces region locks, or refresh rate detections, as the output video signal (at least on composite) seemed to be 60Hz ntsc. A couple of titles we found issue with were Sonic Spinball (PAL), and Sunset Riders (PAL) which will not work in this unit. Oddly enough, a PAL copy of Flashback worked perfectly well in the system. It will really depend on whether or not there is region locking on the game.

Also worth mentioning are the wireless controllers. These worked fine, with no discernable lag. Each controller needs two "AAA" batteries,

All in all, it's a pretty solid system, especially if your focus is US/Japan games. Mileage may vary though for PAL users, so be warned that not all PAL games will work. 🌀



The clone features both composite and HDMI outputs, and a switch for US or Japanese compatibility.



Tiny Toons Adventures... now that takes me back. It looked pretty authentic on our CRT composite display, enough that I could smell the Teen Spirit of the 1990s...

PROS:

- Based on GOAC, not emulation
- HDMI Support
- Very clear composite output
- Audio is good quality (close to a real system, unlike AtGames)
- Timing for games seem to be spot on
- Decent enough wireless controllers which don't seem laggy.

CONS:

- Lack of PAL region support (certain PAL games will not work, some do)
- Audio is mono mix
- Headphone jack didn't work for us (maybe a bad unit?)

OVERALL:

7/10

THE FIRST WEST COAST COMPUTER FAIRE

Held on April 16th-17th 1977 in San Francisco, California, the first West Coast Computer Faire is widely considered the "birthplace" of the personal computer industry.



As we continue on into the next aisle we find Apple Computer, once again with a beautiful display: an Advent projection TV device showing color graphics. Apple is demonstrating for the first time at this show the Apple II computer system.



The Apple II's dazzling colour graphics stole the show. Apple used a video projector to draw attention to their booth, where they also spruiked their built-in BASIC featuring commands to actually use those graphics – a novelty in 1977!

Organised by Jim Warren, a computer programmer who would go on to host the first two seasons of the PBS show "The Computer Chronicles", and Bob Reiling, the Faire was their attempt to popularise the use of computers outside of science and big business.

Two computers that would go on to success in home, small business and education were debuted at the Faire – the Apple II, presented by a 21-year old Steve Jobs, and the Commodore PET, presented by Chuck Peddle, the main designer of the 6502 microprocessor common to many 8-bit computer models.

As I walk into the main exhibit hall, both eyes and ears are assaulted with a variety of sounds. A number of music and speech synthesizers are all playing and talking at once. In addition, many people have displays using Advent projection-tv devices so that there's a virtual kaleidoscope of colors and sounds throughout the exhibit hall. This late in the day it's still difficult to move up and down the aisles. The aisles are crammed wall to wall, with four to six people deep around each booth. I found earlier it took an average of 15 minutes to get into a typical booth to talk to anybody in depth. There are approximately 140 booths in the main convention area and another 30 booths, actually mini-booths, around the outside of the main room—175 exhibitors in all.



Attendance numbers surprised even the organisers. Jim Warren told David Ahl that the Faire resembled "a mob scene." Close to 13,000 people attended over the two days, many of those not computing hobbyists, but "regular" people curious about the oncoming computer storm.





Personal Computing: Tell us how the PET got started.
Chuck Peddle: Primarily, it's an attempt on Commodore's part to capitalize on vertical integration. When they acquired MOS Technology [Ed. Note: MOS Technology is the company that developed and has been manufacturing the 6502 microprocessor employed in a number of personal computers such as the KIM, Ohio Scientific, and Apple], giving them the semiconductor base they needed to be a major factor in the calculator and games market, the next question was: "What do we do for a major microcomputer base technology?" Personal computing was just starting to be a real market back in October and November of 1976.

The Commodore PET ("Personal Electronic Transactor") 2001 was only black-and-white and didn't actually have any graphics beyond the character set, but compared to the Apple II it was *dirt cheap* and people flocked to Commodore's booth to see if the rumours were actually true.

Continuing on down to the next aisle we have a huge crowd gathered around the Mr. Calculator booth. This is the place where the rumored Commodore system is being shown. The \$500 computer with 12K memory, cassette and TV interface, and keyboard is self-contained in a small cabinet. If the \$500 price comes true it would certainly be a revolutionary development in the whole field.

The first West Coast Computer Faire was an unqualified success, and the organisers eagerly planned the next one for the following year, where the world's first microcomputer chess tournament was held, won by Sargon. At the fourth Faire in 1979, VisiCalc was demonstrated – the first spreadsheet application for personal computers, VisiCalc made the PC a serious business and scientific tool, and directly influenced the commercial success of the Apple II.

The last Faire was held in 1991.



The TRS-80 wasn't actually shown at the West Coast Computer Faire – its debut would come later in the year in Chicago. But the TRS-80 completed what the press called the "Holy Trinity" of 1977 personal computers, bringing affordable computing to the public for the first time. The TRS-80 sold for US\$500.



For example, Radio Shack will unveil its new \$598 complete computer with typewriter keyboard, memory, cassette recorder, video screen and programming. Is it everything that people in the electronics industry are saying it is? You can see for yourself in Chicago.

BACK IN THE DAY



Thanks to
all of our
generous
supporters!

Ken Gagne
Emma Cooper S
Nick L
Ish Ot Jr
Craig McLean
Andy Ayres
Scott K
Iain Chalmers
Margaret Anderson

Juan Pablo Schisano
Paul Crabtree
Joachim Froholt
Tieg Zaharia
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Paul Monopoli
George Bachaelor
& David Stephenson



wozfest

WozFest DB9, the recurring Sydney, Australia-based meeting of Apple II enthusiasts, held its latest installment on April 28th – and it was a full house!

The theme was communications, and in that spirit there was a trans-Pacific demonstration of Oliver Schmidt's **HFS65** software for the Uthernet Apple II ethernet card. HFS65 allows you to download disk images directly

from an Apple II's disk drive. Unfortunately, it doesn't serve web pages (yet.) We also looked at the **Wombat**, a USB to ADB adaptor. Attendees worked on their own projects, and a great time was had by all!

There was even a link across the ditch with Apple II figure Tony Diaz, who stayed up late to join in on the fun.

It wasn't all Apples though! There was a guest appearance by the venerable **Nintendo Famicom**, sporting keyboard and BASIC cartridge. In this configuration it really is a Family Computer!

Looking forward to next time!

Finger food and much cider were consumed by attendees, snacks and screwdrivers sharing space on the ping-pong table that takes up most of the 'Man Cave'...



REVISITED



Meanwhile, over in the USA...

kansasfest

UPDATE

KansasFest increased the number of available places this year to 120 – which is a good thing, because 80 spots were filled only days after registrations opened!

This year's keynote will be given by Apple veteran Roger Wagner. Roger authored the first book on Apple II assembly language programming, **Assembly Lines**. He was also a contributing editor of Softalk magazine and contributed to other magazines including Call-A.P.P.L.E., Nibble and inCider.

In addition, there will be presentations by many other attendees about Apple II hardware, software, emulation, restoration and more.

The famous **Garage Giveaway** is also making a return, but this year could be its last...

So if you're considering attending, make sure you get your ticket soon!

Roger Wagner



The Vintage Computer Festival

The **Vintage Computer Festival**, founded in 1997, promotes the preservation of "obsolete" computers by giving the general public a chance to experience the hardware, software, people and stories that are involved in computing history. VCF is held in several locations throughout the year, including New Jersey, (VCF East), Seattle, Washington (VCF Pacific Northwest),

Mountain View, California (VCF West), Chicago, Illinois (VCF Midwest), and Atlanta, Georgia (VCF Southeast) as well as non-US locations such as Berlin, Germany; Zurich, Switzerland and Great Britain.

VCF events include keynote speeches, hands-on exhibit halls, and technical demonstrations and classes.

You can learn more about the Vintage Computer Festival on its organiser's website at www.vcfed.org



Upcoming Events

Three VCF events are over for this year (Pacific Northwest, South East and Italy) but there are still a few more to come...

Vintage Computer Festival Midwest
Elk Grove Village, IL

September 15-16, 2018
www.vcfmw.org

Vintage Computer Festival East
InfoAge Science Centre, Wall, NJ

May 18-20, 2018
www.vcfed.org

Vintage Computer Festival West
Computer History Museum, Mountain View, CA

August 4-5, 2018



This French Apple II Festival looks pretty cool, but you may want to brush up on your français.



Portland Retro Gaming Expo
October 19-21 Oregon Convention Center, Portland Oregon

The Portland Retro Gaming Expo features 30,000 square feet (9144m²) of full-sized arcade cabinets and pinball machines all on free-play. There will also be a wide variety of consoles and console games to play, a vendor fair, a collectible auction, and speakers and guest panels. For more information: www.retrogamingexpo.com

Apple II Festival France
August 1-5 2018

The French have their own Kansasfest-style celebration of the Apple II, a five-day festival in its 4th year. Like Kansasfest, attendees can sleep on-site. For more information: www.apple2festivalfrance.fr

Adelaide's annual gaming expo usually has a retro-gaming area featuring a few vintage arcade cabinets, and dozens of consoles and computers. More information: www.avcon.org.au

AVCon Adelaide
July 20-22 2018

Adelaide Convention Centre

Do you know of an event that should be listed here?
E-mail the details to editor@paleotronic.com



COMMUNITY CALENDAR

What's happening,
and what happened?

Community Calendar is the place to find out about exciting upcoming events, conferences, conventions and more, and get updates, reviews and anecdotes about recent activities in the retro-technology community.



r/MAME focuses on arcade game emulation, and construction of MAME-based arcade cabinets.

r/CRTGaming discusses the repair and restoration of vintage televisions and computer monitors.

r/BBS lists new bulletin-board systems, and helps visitors with starting their own.

usenet

comp.sys.apple2 is an extremely high-traffic usenet list about all things Apple II! If you're interested in getting into 8-bit computing, this is a good place to start, if only to get a taste of the depth of the subject matter, and the enthusiasm many people have for it...

Companion groups **comp.sys.apple2.programmer** and **comp.emulators.apple2** talk about Apple II programming and emulation respectively.



Retro Roundup sends out daily digests of updates from a number of retro-related blogs. Subjects include vintage home computers, video-game consoles, news and upcoming events.

You can subscribe at retroroundup.com



Reddit has a variety of "subreddits" on retro-gaming and retrocomputing topics. Here's a small selection of some of the more popular or notable ones:

r/PixelArt features posts by "pixel artists" who create 8-bit-styled still and animated artwork.

r/RetroGaming contains a wide variety of vintage console gaming discussion.

r/RetroBattleStations does similar for vintage computing.

r/chiptunes showcases new 8-bit-style music.

UseNet is a good source for retrocomputing discussion and information. You can access UseNet groups through groups.google.com and subscribe to have new posts sent to your inbox!

Other retro-related UseNet groups:

comp.sys.cbm	Commodore discussion
comp.sys.sinclair	Sinclair discussion
comp.sys.tandy	Tandy (Radio Shack) discussion
comp.sys.TI	Texas Instruments discussion
comp.sys.acorn.*	Several sub-groups about the Acorn computer family
comp.sys.amiga.*	Several sub-groups about the Commodore Amiga family.

ClassicCmp maintains two well-traveled mailing lists dedicated to "classic" computing, which they define as topics related to any computer or software more than ten years old. There's a casual discussion list that allows for off-topic chatter, and a strict on-topic list for those who don't want unrelated banter.

You can subscribe to either list at classiccmp.org

The **Apple IIoz** mailing list connects Australian Apple II enthusiasts with each other for information and to organise meetups. Subscribe by sending an e-mail to mail-subscribe@appleiiioz.com

Retro Computing Roundtable (**@RCRPodcast**) releases monthly podcasts that delve into various aspects of the retrotechnology community including events, new products, auctions for vintage hardware and more. www.rcrpodcast.com

Hosted by Mike Maginnis and Quinn Dunki, the Open Apple Podcast talks about all things Apple II www.open-apple.net



THE BBS LIST

internet resources

facebook

Members of the [8-Bit Computer Clique Facebook](#) group post about all sorts of early 1980s computers, including new product announcements.

If you're looking to discuss anything more recent, [Retro Machines](#) allows members to talk about any computer more than a decade old.

twitter

C64audio ([@C64Audio](#)) is working on a multifaceted project related to Commodore 64 musician Rob Hubbard, including a book, game and music.

Antoine Vignau ([@antoine_vignau](#)) is an Apple IIGS programmer who posts and retweets about all kinds of Apple II stuff.

BBS bulletin board systems

A 80's Apple II BBS: [a80sappleiibbs.ddns.net:6502](#)

This BBS is running on a live working Apple II serving data off of real floppy disks. Because of that only one user can connect at a time, so if at first you don't succeed, try again later (just like the old days!)

chat rooms

[irc.freenode.org](#) hosts several retrotechnology-related channels including [#C64](#), [##amiga](#), [##atari](#), [#retro-computing](#) and [#classiccmp](#)

www: ftp:

[www.racketboy.com](#) features articles on retrogaming, including collecting, and forums on various retro topics including a marketplace.

Facebook group [The CRT Collective](#) is a celebration of the cathode-ray tube. Members share their CRT collections and assist other members with troubleshooting and repairs. [www.facebook.com/groups/444560212348840/](#)

[CED Magic](#) looks back at the SelectaVision video disc system, a video record player!

[Apple II Enthusiasts](#) is one of the largest retro-computing groups on Facebook with over 5000 members.

[I Am A Classic Videogamer](#) covers all vintage consoles and arcade games with news and reviews.

Digital archivist Jason Scott ([@textfiles](#)) posts about current news and events in the retrotechnology community. You should also follow his cat, [@sockington](#)

Yesterbits ([@yesterbits](#)) has a feed chock-full of retrocomputing goodness.

4am ([@a2_4am](#)) releases a constant stream of previously unarchived Apple II software.

DataDoor ([@datadoor](#)) posts PETSCII art and 8-bit computer generated music.

Did you know that you can "call" hundreds of telnet-connected BBSes via a vintage Apple II terminal program using [microM8](#)? Get it from [microM8.com](#)

The [Telnet BBS Guide](#) is the largest active listing of telnet-accessible bulletin board systems on the Internet: [www.telnetbbsguide.com](#)

Absinthe BBS: [absinthe.darktech.org](#)

In contrast, this multiline Amiga-based BBS has multi-user chat and gaming.

Apple II Slack group [Apple2Infinitem](#) is hopping with discussion about all things Apple II. Signup at: [http://apple2.gs/slack](#)

Chat about all things Apple II on A2Central's IRC server. Point your IRC client at [irc.a2central.com](#) and join [#a2c.chat](#)

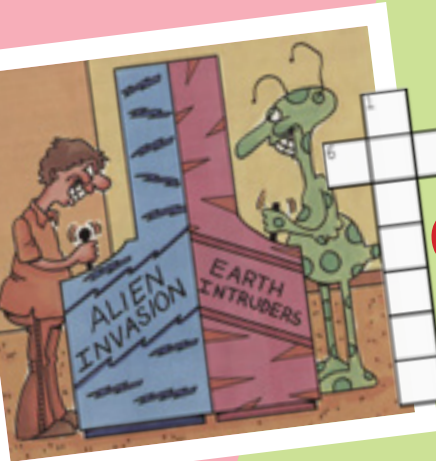
You can connect to IRC servers using [XChat](#) available at [xchat.org](#) (Windows or Linux) or [XChat Azure](#) available on the Mac App Store.

[ftp://ftp.apple.asimov.net/pub/apple_II/](#) features a gigantic collection of vintage Apple II software and documentation organised by category.

[www.lemon64.com](#) hosts games and reviews on thousands of classic Commodore 64 games. It also features a gallery of graphics, a music archive and a collection of game box art.

Do you have something to add to this list? E-mail [editor@paleotronic.com](#)

The Fun Zone



CRT

cross

word

Across

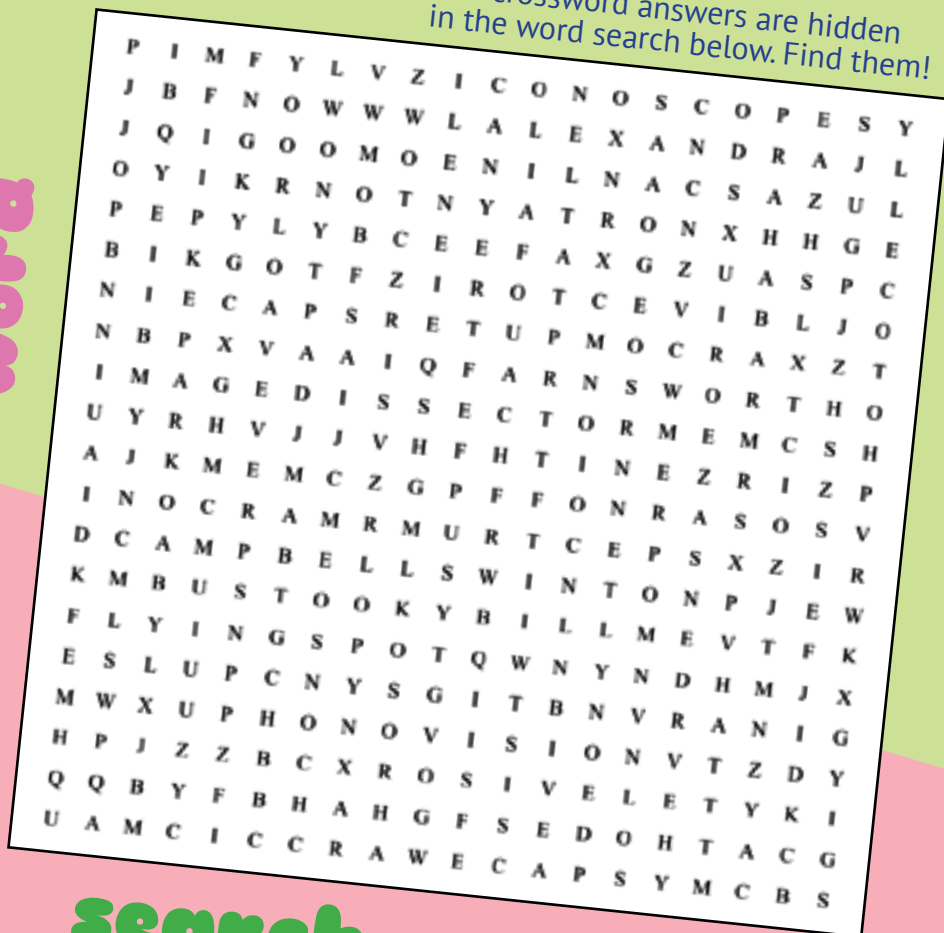
2. TV band.
3. RCA boss.
6. Ray's tube.
8. Brit's teletext.
10. First sampler.
11. Beeb's palace.
15. British broadcaster.
16. Spinning disc.
18. Won the TV race.
20. Baird nickname.
21. Altwasser's machine.
23. Mechanical television.
24. Cathode ray.
25. Farnsworth's folly.
26. End of line.
27. The height of television.

Down

1. Radio guy.
2. Not raster.
3. First video game.
4. Russian TV mastermind.
5. Electric eye.
7. John's middle name.
9. Fully electronic was his way.
10. Idaho farmboy.
12. Disney movie.
13. A real dummy.
14. First arcade video game.
17. Antique VCR.
19. Camera that's not a camera.
22. First person televised.

The crossword answers are hidden in the word search below. Find them!

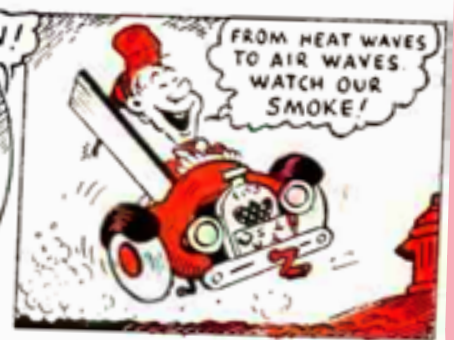
Word



search



SMOKEY STOVER



OAKY DOAKS



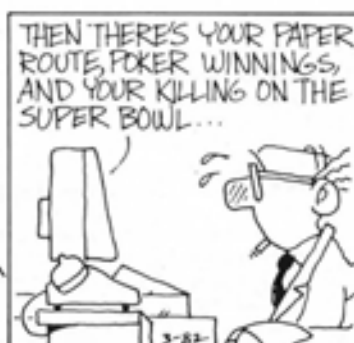
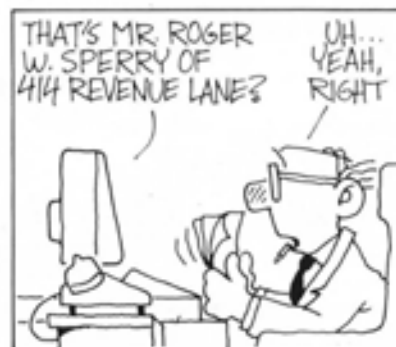
THE KATZENJAMMER KIDS

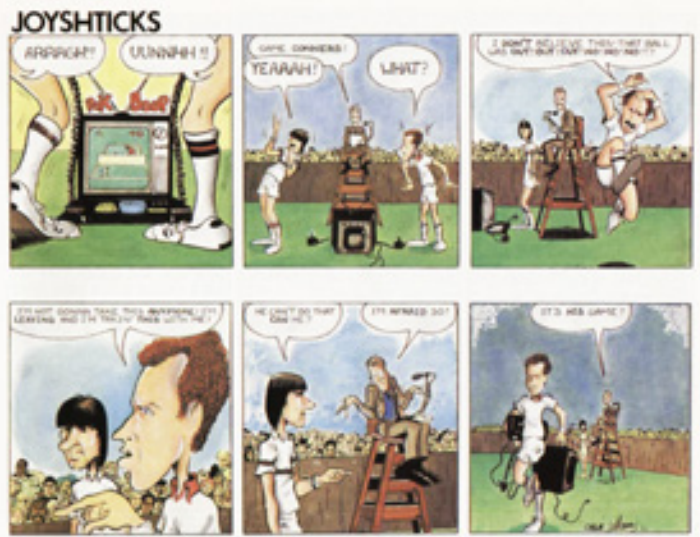
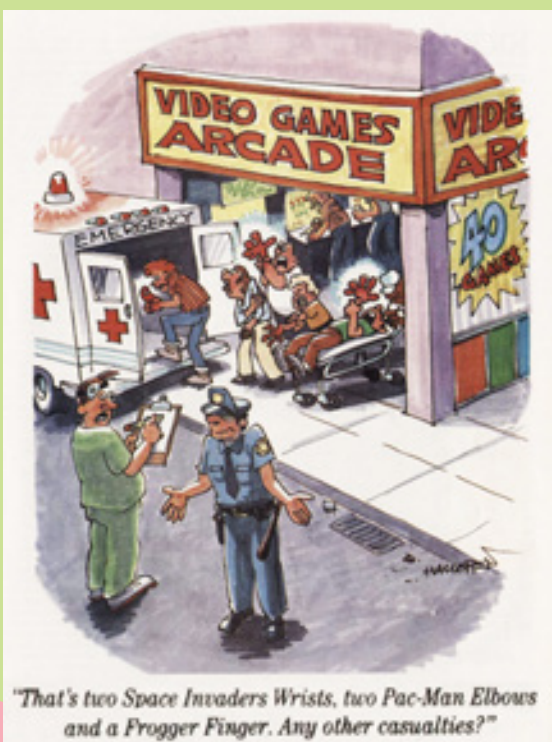


MACHINE HEAD

comics!

BY SPYDER





The three television-related comics at the top of the previous page demonstrate the excitement the American public had for television in the early 1950s. The Machine Head comic from 1982 speculates on the power of the emerging home computer market to get people into (and out of) trouble.

On this page, The Video Kid is back this issue. The titular character monopolises a Dig Dug machine until distracted by the antagonist, falsely announcing the arrival of a new game based on... Dolly Parton?!? Oh, the 80s... Joyssticks, meanwhile, makes fun of tennis games like Pong.



This 1983 Bernie cartoon makes light of contemporary commercials which claimed their primitive video games were “just like being there”, by speculating as if they actually were – with an explosive punchline!

Finally, the main character in comic strip Zippy decides to cash out their life savings to play video games, in an attempt to experience what it is like to be a 1980s American teenager.

quantum link
 interactive
 fiction
 nintendo's NES
 amiga's
 soundtracker
 the jockintosh

interviews:
 steve wozniak
 talks disk II
 jason scott
 and 4am
 stewart cheifet
 revisits CES

...and so
 much more!

The Magic of
CES

previous issues...

In our premiere issue, we looked back at the history of the Consumer Electronics Show and the products that were launched there, including the Commodore 64, the Atari ST and the Nintendo Entertainment System.

Its pages also contained comprehensive interviews with Apple co-founder Steve Wozniak and The Computer Chronicles producer and host Stephen Cheifet about their experiences at CES. There's even a look back at the Apple Pippin!

So if you missed it, make sure you get a copy. It's 115 pages of retro-technology goodness you can't get anywhere else.



Don't have a copy? Never fear! Simply visit paleotronic.com and order a backissue. Print copies are still available! Thanks for reading Paleotronic.

The Parting Shot

"This brings to a close a another broadcast day..."

Today we've seen for ourselves just how much the cathode-ray tube affected society, the world at large and our modern lives, from entertainment, to work and to warfare. Were it not for the CRT things would've worked out quite differently. (That would be a great hook for a speculative science fiction novel!)

So, while the CRT is now obsolete, all of the technologies it spawned – television, radar, video games and computers as we know them – soldier on, having been shaped by the tube forever.

Next time you're playing Mario of whatever incarnation, or watching your favourite show, spare a thought for Karl Braun – you couldn't have done it without him.

P.S.

We're moving to a quarterly schedule because good history takes... erm... time.

I'm learning that to cover a topic as comprehensively as I'd like (and have news and other stuff as well) is taking longer than I'd expected, and so rather than leave things on the cutting-room floor I think it's ultimately better to just spend the extra time to get it right.

We're also going to KansasFest in July and from Australia that's quite the trip! But don't worry, subscribers will still get all the issues they paid for, they'll just be a little more spread out. For now, at least – as more people come on board, issues are sure to become more frequent. -Ed

Editor: Melody Ayres-Griffiths

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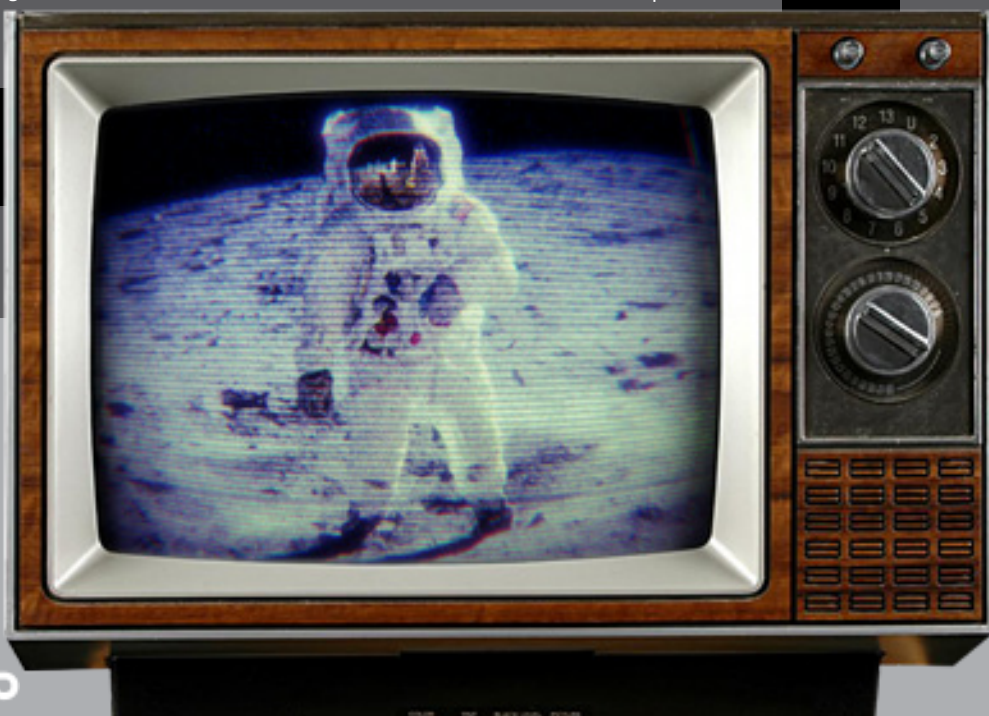
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Coming Up

Next Time...

To the Moon! Our next issue is going to explore all things electronic related to our friendly orbiting satellite. So tune in and join us as we look at the DSKY, Apollo's flight computer; the televising of the Moon landings; video games Lunar Lander and Moon Patrol and more!



Writers Wanted

te sail on ye goode shippe **Paleotronic**.
Thar be plenty of **ale** and **grog** for which-
ever **scurvy dogs** what deign to join us in
our grand voyage of **piracy** and **plunder**.

Ye must be carrying of
quick wit, and **fancy**
wit' yer scrawlings. Ye
must also be feelin' a
yearning for the scribe's
life on the retro-technol-
ogy seas. **Ye must also**
know who this wicked
scoundrel is here, but
never mention his cursed
name in our presence!

I' apply, use yer electric
oracte and raise a flag at
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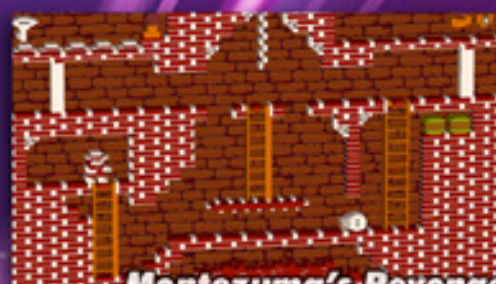
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Robotron 2084



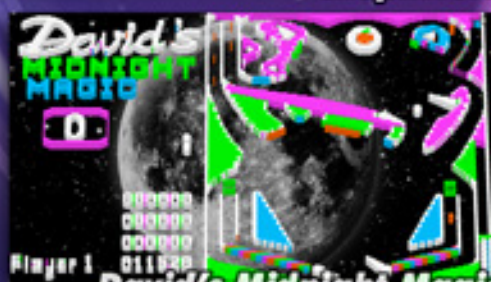
Choplifter!



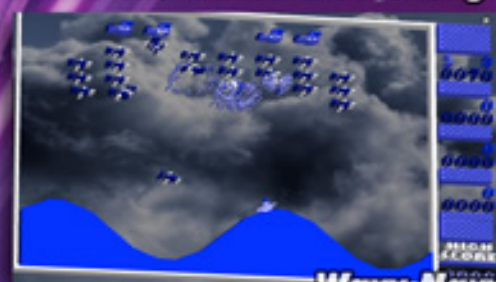
Montezuma's Revenge



Alien Typhoon



David's Midnight Magic



Wavy Navy

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