The History of Atari: 1971-1977

By Steve Fulton

Mt. Fuji towers 3776 meters as Japan's highest mountain. It's a striking landmark, one that rises almost impossibly out of an unassuming plain to a pinnacle of ice-capped beauty. After its mammoth breadth is realized, it settles back down again into a valley as if it was never there. It was formed by a volcanic eruption about 10,000 years ago, and has since been worshipped as a sacred landmark by the Japanese. In the shadow of that mountain, the people of Japan have played a strategy game named Go for thousands of years.

Mount Fuji, taken by [Asela Jayarathne](#)

First created in China about 2000 B.C., Go is a compelling and subtle strategy game. It vies with Parcheesi as the world's oldest game that still exists in its original form. Go is unique, in that there are literally trillions -- if not an infinite number -- of board combinations. So many, in fact, that it is theorized that no two Go games played have ever been, or will ever be the same. Yet the game looks so simple -- just a series of black and white stones placed on a 19x19 grid.

Some players have described the binary pattern of stones as a thing of beauty, with the game attaining a level of complexity at times so vast, the players put more emphasis the complex stone patterns to help them decide their next move, then on any sort of strategy.

It's no small wonder that the simple beauty of a game like Go appealed to the college campus computer hackers of the 1960s. While chess was still very popular, its regimented opening moves and seemingly finite strategies were more in-tune with the "powers that be" than with new movements based on social change. Computer hackers were opening new doors to information that were only dreamed about a decade prior.

Go's binary nature -- like that of a computer -- appealed greatly to these pioneering computer enthusiasts. It was a game of infinity, that could be explored and experimented upon, just like the computing machines the hackers coveted so much. However, the infuriating part of Go is that it's almost impossible to master. For a group of people who wanted to explore every nook, cranny, and corner of a computer, the inability to "master", this must have been both cathartic and frustrating.

Atari founder Nolan Bushnell was a Go player who learned the hacker ethic at the University of Utah. When Bushnell finally decided on the name for his pioneering video game company, he called it "Atari". In Go terms this is like saying "watch the hell out, I'm just about to win the game". A couple years later, Atari would adopt a curious looking logo -- a three-part, vertically split triangle, that looked a bit like an "A", but more like a mountain.

This symbol would commonly be known as the "Fuji", and it was under its shadow that an entire new industry was created. It was also under this shadow that the simple lessons of Go would affect the design of video games in their first decade. The "simple to learn, difficult to master" game design philosophy is the one that helped propel Atari's games from mild parlor amusements into the psyche of an entire generation.

The Engineer Entertainer

Born in 1943 in Clearfield, Utah, the founder of the modern video games industry, Nolan Bushnell, always loved playing games.

"I can remember playing Monopoly and Clue with my neighborhood friends, chess incessantly. I played tournament chess. I played #2 board at Utah State University. I've always been a game player, period" [i] -Nolan Bushnell

He also loved science. His world was upended in 3rd grade he was given a science assignment by his teacher Mrs. Cook.

"The spark was ignited when I was assigned to do the unit on electricity and got to play with the science box. I remember constantly making stuff as a kid that amazed my friends using electricity." [ii] - Nolan Bushnell

With a love of play, and a love of science, an engineer entertainer was born.

Bushnell's love of electricity led him to Utah State University where he studied for a BS degree in Electrical Engineering. While in the engineering department, Bushnell was exposed to a DEC PDP-1 computer, and Steve Russell's game *Spacewar!* He fell in love with the quirky little one-on-one space battle game, and was fascinated by the impact it had on the other students, especially in how much free time the other students spent playing it.

At the same time, Bushnell was working his way through college by working at Lagoon Amusement Park in Farmington Utah. There, he worked the midway games like a master carnival barker.

"I think that working at the amusement park gave me a sense that I had a special knack for that. I was able to have a lot of people have fun and spend their money while doing it. Those were two good characteristics" [iii] - Nolan Bushnell

Near the midway was a small arcade that featured mostly pinball machines. Bushnell envisioned the day that the pinball games would be replaced by machines playing games like *Spacewar!* He noted how much free time his classmates were spending on the game. He realized that if he could figure out a way to monetize that time, he could be very successful. However, after much pondering, it seemed impossible. A DEC PDP-1 computer cost $120,000, and there was no way someone could break even on a game that cost that much create.

"When you divide 25 cents into an $8 million computer, there ain't no way," [iv] - Nolan Bushnell

He put the notion aside so he could start a career as an engineer. After graduation from Utah State as a "Distinguished Fellow" in 1968, Bushnell moved to California where he continued his graduate education at Stanford University. He wanted to work for Walt Disney, because he felt they were doing very interesting things with technology. Even though

Bushnell thought of his endeavors as technical feats, he still felt the need to entertain people.

"I always considered myself an engineer. A guy who used technology to solve problems. I was fascinated with Disney who used technology to entertain people. I felt technology was truly magical." [v] - Nolan Bushnell

However, since, Disney did not hire engineers straight out of school, so he had to look elsewhere.

"When I graduated from college, my vision of the perfect job was to work in the research section of Disneyland. But they weren't hiring new engineering grads. " [vi] - Nolan Bushnell

Bushnell found a job at Ampex Corp, in the Silicon Valley and started working as computer graphics department research designer. He worked at Ampex for a couple years, where he met fellow engineers (and future Atari employees) Al Alcorn and Steve Bristow. However, Bushnell was never able to settle down as a line engineer. The need to entertain people kept biting at him. Soon after, he was introduced to a free-standing version of *Spacewar!* named *Galaxy Game*, designed by Bill Pitt, another Stanford graduate.

Galaxy Game was a full version of the DEC PDP version of *Spacewar!*, right down the mini-computer that was necessary to run it. While the technical feat of a free-standing *Spacewar!* game was impressive, the $40,000 cost associated with basing a game on mini-computer was not. Bushnell knew he could do better. His day dreams of electronic games replacing pinball machines from working at Lagoon were rekindled. He felt he could engineer a machine that could entertain people, and still make money at the same time.

Simplifying A Revolution

In the Spring of 1971, while still working for Ampex, Bushnell along with fellow engineer Ted Dabney, started crafting their own version of *Spacewar!* named *Computer Space*. They worked out of Bushnell's daughter Britt's bedroom, turning it into a computer lab in which they could engineer their masterpiece. All sort of ideas crossed their minds, including using a minicomputer like *Galaxy Game*, and using a series of terminals for a multiplayer experience, but these ideas were far too expensive for this bedroom outfit.

Instead, it hit them one day to go in the opposite direction and simplify their design to cut costs as much as possible. The pair decided that they did not need thousands of dollars in hardware to make their dream come to life, instead choosing a much simpler solution. They crafted a working game using TTL (Transistor To Transistor Logic)[vii] to create a computer whose sole purpose was to play *Computer Space*. While this might have seemed like a step-back technology wise, it was a huge leap forward for creating a commercial game. With a black and white G.E. TV and $100 worth of electronic parts, they created the first viable, commercial video game.

"I worked it out and the economics were overwhelming."[viii] - Nolan Bushnell

This seemingly simple decision towards simplification fueled the entire video game industry for most of the 1970's.

"100% of the video games up until 1977 used my discreet logic technology... that I had a patent on." [ix] - Nolan Bushnell

However, before a video game revolution could be started, it would need a game that people wanted to play. Unfortunately, *Computer Space* was not that game. Bushnell and Dabney sold their idea to Nutting Associates in late 1971. It landed in the coin-op industry with a resounding "thud". Amusement operators who were used to buying jukeboxes and pinball machines had no idea what to do with it. The controls were too complicated, and the game too confusing for the average barroom (read: drunk) player.

NA-2010

"Nobody wants to read an encyclopedia to play a game"[x] - Bushnell on *Computer Space*

In the spring on 1972, while still working with Nutting to sell *Computer Space*, Bushnell visited Magnavox to take a look at the TV video game system that Ralph Baer had developed for the company. Bushnell left unimpressed. The analog computer used in the game (a computer used for applications that require a continuous change of one or more variables) was only useful for very simple games, and the graphics looked fuzzy. However, a simple tennis contest on display stuck with him, and the idea for a ping pong-type game was born.

1972: Atari Is Born

On June 27th, 1972, Nolan Bushnell and Ted Dabney officially created their own company named Syzygy Co., each contributing a $250 share -- mostly from the meager profits earned from *Computer Space*.[xi] Bushnell said they decided on Syzygy because "I thought it was a cool name when I found it in the dictionary".[xii] However, they soon discovered that the name Syzygy was already taken by a roofing company.[xiii] Although they continued to use it for couple years afterwards to describe their engineering process, they had to choose another name.[xiv] Bushnell suggested "Atari", a hold-over from his days as Go player at Utah State. Atari roughly translated to "you are about to be engulfed"[xv], which they thought sounded pretty cool at the time and also served another purpose.

"I thought Atari was a good warning to the competition in the gaming industry" [xvi] - Nolan Bushnell

They started their new business on two fronts. While Bushnell went ahead to start designing a new video game, Ted Dabney used some existing equipment to start a coin operated game service business.

"When we did Computer Space *there were about 7 prototype units that were really not to standard that could be sold to 3rd parties. We saw them as an opportunity and we put them on location and collected the quarters every week. When we did that some of the places wanted pinball so we started buying equipment and collecting the quarters. That was one of the early ways we financed the business."* [xvii] - Nolan Bushnell

In the spring and summer of 1972, Atari began the engineering process for their first game. To augment their team, Atari hired one of Bushnell's fellow Ampex employees, Al Alcorn, as a senior engineer. To lure Alcorn to Atari, Bushnell told him a little white lie: that he had a contract with G.E. to create a home version of *Pong*.

"Nolan told me that we had a contract from General Electric to design a home video game on a ping-pong theme."[xviii] - Al Alcorn

Atari did have a tentative contract (with Bally, to create a driving game) but Bushnell wanted Alcorn to cut his teeth on something simple for his first effort. The primitive ping-pong game Bushnell had seen at Magnavox seemed like a good candidate.

"I had to come up with a game people already knew how to play; something so simple that any drunk in a bar could play."[xix] – Nolan Bushnell

Neither Alcorn nor Bushnell were impressed with Odyssey and its analog components, so the game would have to be improved. In any event, *Pong* was only practice, and Bushnell did not plan to take it seriously. "I thought it was going to be a throwaway," Bushnell told Playboy Magazine, "but when he (Alcorn) got it up and running, it turned out to be a hell of a lot of fun." [xx]

Just like *Computer Space*, *Pong* was a TTL discreet-logic machine. It had no microprocessor, but instead used individual chips to create the logic for the game. The key to saving money was to design the game so well that it used the fewest number of chips.

"I had the prototype running in three months and I was very disappointed because it had about 75 TTL IC's and would cost way too much for a high volume home machine. It turns out that Nolan had something else in mind. He lied about the contract with GE and gave me this project because it was the simplest game he could think of and he just wanted me

to practice on something." [xxi] - Al Alcorn

Alcorn added small details like ball English and simulated physics that went beyond Bushnell's original concept, but still kept the design elegant, and cheap.

"Since I was under the impression that this was to be a real product I worked hard to make it playable and inexpensive." [xxii] - Al Alcorn

After Nolan Bushnell saw how well *Pong* was turning out, he and Ted Dabney decided to test-market it at one of the locations on their pinball route, Andy Capp's Tavern in Sunnyvale California. [xxiii] It was an almost instant success. People started lining up before the bar opened just to play the game. Some wouldn't even order anything -- just play *Pong*. Unlike the pages of instructions for *Computer Space*, *Pong* instructions are the model of simplicity: "Avoid missing ball for high score."

"Two weeks after installing the game, Al Alcorn got a late-night phone call from the manager of the bar. The game had broken down, and he wondered if he could fix it. When Alcorn went to check the machine, he found a most unusual problem. There were so many quarters jammed into the coin drop that the game had stopped working. [xxiv] Under the coin-drop was a plastic milk jug with the top cut off, and it was filled with quarters, making the "credit" mechanism not work.

"When we first put it on location I asked Nolan what would constitute good performance. I think he said that if it did $25 a week that would be a good game. It was doing over $100 per week right away." [xxv] - Al Alcorn

"At that point in time, I knew I had a successful business." [xxvi] - Nolan Bushnell

A successful test-market, however, did not mean instant sales. In the fall 1972 Bushnell set out on a road trip with a portable version of Atari's *Pong* machine to look for potential buyers. The *Pong* game was offered to Bally first, but they declined to purchased it, preferring a game that did not require 2 players. Bally had contracted Atari to do a driving game, and Nolan tried very hard to get them to accept *Pong* instead, but Bally refused.

Other amusement manufacturers at the AMOA trade show didn't "get it" either. In 1972, the pinball and other amusement game manufacturers made machines with many electromechanical and moving parts. *Pong* had only two moving parts and this baffled them. They didn't understand or envision the industry changing.

Instead of persuing established manufacturers, Bushnell decided to manufacture *Pong* himself. It was not an easy sell to Dabney or Alcorn, who thought Atari was a technology company that would license its inventions, not manufacture them.

"Nolan had to convince us to be in the manufacturing business. In the end it turned out to be the best strategy" [xxvii] - Al Alcorn

It was his boldest move yet, and would prove ultimately successful. He leased an old roller rink in Santa Clara and converted it into a production line manned by low-paid hippies. The first *Pong* game shipped from this facility in November 1972. [xxviii]

On November 19th, 1979 *Pong* was officially released,[xxix] and the "Steam Age" of the coin operated video game began.

1973: *Pong* Is A Smash Hit!

"As a result of Pong*, a player can gain a deep intuitive understanding of the simplest Newtonian physics."* [xxx] - Carl Sagan

By March of 1973, *Pong* was deemed a bona fide phenomenon for Atari. They had sold 8000 - 10000 machines, and would eventually sell upwards of 35,000. The day *Pong* was released is marked by the coin-op industry as the first nail in the coffin of pinball. [xxxi]

Atari was so successful in its first year for two reasons. First, they used an early version of a "Just-In-Time" manufacturing processes.

"With expensive parts, such as cabinets, we tried to get them out the same day they came in and we made sure that 75% of the cost turned over in less than a week." [xxxii] - Nolan Bushnell

Secondly, Atari also took advantage of the soaring demand for *Pong* by insisting on cash payments from distributors instead of going along with the longer terms common in the coin-operated game industry. [xxxiii]

By March of 1973, Atari had made a little over $3.2 million dollars. However, there was a black side to this fortune. Atari's patent for *Pong* took a long time to clear -- too long to stop a myriad of copycats from showing-up almost immediately.

"I filed for a patent, but in those days patents took 3 years to issue. I don't think my patent issued until 1975 or 1976." [xxxiv] - Nolan Bushnell

Since the game was designed using a discreet logic TTL design, there was very little they could do to protect their intellectual property. Anyone who owned a machine could open it up, examine the circuit board, and copy it chip for chip. By the end of 1973, there were so many competitors selling *Pong*-style games that Atari was no longer the leading manufacturer of its own game. Some of the copies were made so well that they looked exactly like the original Atari versions.

Some of the *Pong* competition in 1973 included: *Elepong* from Taito, *Davis Cup* by Taito (each player had two paddles), *Computer Space Ball* (1972) from Nutting Associates, *Hockey* by Ramtek, *Hockey TV* from Sega, *Leader* from Midway (a very innovative 4-player *Pong* variant with a wall in the middle for deflection), *Olympic Tennis* from See-Fun (2 or 4 players), *Pro Tennis* from Williams Mfg. Co. (4 players), *Paddle Battle* from Allied Leisure (exact copy of *Pong*), *Paddle-Ball* from Williams (exact copy of *Pong*), *Pong-Tron* from Sega (exact copy of *Pong*), *Pong-Tron II* from Sega (exact copy of *Pong*), *Pro Hockey* from Taito, *Rally* from For-Play, *TV Hockey* from Chicago Coin (exact copy of *Pong*), *T.V. Tennis* from US Billiards (exact copy of *Pong*), *TV Ping Pong* from Chicago Coin (exact copy of *Pong*), *Table Tennis* from Nutting Associates (exact copy of *Pong*), *Tennis Tourney* from Allied Leisure (4 player *Pong*), *Winner* from Midway (an exact copy of *Pong*) and *Winner IV* from Midway.

Atari could have fought each one of these copycats -- but they could not afford to do it.

According to Nolan Bushnell

"Atari was always scrambling for cash, and we thought to spend money on attorneys was not a smart thing to do." - Nolan Bushnell

However, it wasn't just the copycats Atari had to worry about, it was other legal problems as well. Magnavox and Ralph Baer did not take kindly to the success of Atari's *Pong*, especially since they had created a very similar game more than a year earlier. They took Atari to court, suing them over *Pong*. They used the sign-in-sheet for the 1972 Magnavox demo that Bushnell attended as proof that he saw the Magnavox video games before he came up with his own idea. However, Bushnell maintained that while he might have seen the Magnavox product, his was far superior:

"They did an excellent job of creating a game using analog circuitry, but it just wasn't fun." [xxxv] - Nolan Bushnell

Skillfully, Nolan Bushnell turned this legal problem into an advantage for Atari. Atari settled with Magnavox, and the case never went to court. They paid a licensing fee close to $500,000 and became the sole licensor of *Pong* from Magnavox.

"It was a strategic thing. Magnavox was desperate to settle with me. They had seen lab books and I had been in business for two years before the Odyssey game was supposed to hit the streets. We settled basically for an amount of money that was less than I was spending on attorney's fees at the time. $500,000 paid over five years. Less than 1/10th of 1%. It was a usage royalty." [xxxvi] - Nolan Bushnell

"As far as we were concerned, that was the end of our problems with Atari" [xxxvii] - Ralph Baer

Magnavox then agreed to go after all of Atari's competitors as part of the deal, which basically freed Atari to create new and different games while the competition was stuck in court.

"In our agreement we required that they go after all our competitors. Literally, I felt that if we could keep everyone else distracted and paying money, that could only help our business. I was not worried about Magnavox being a competitor. It was a strategic business move. Any time you can damage your competitors, walk away from it with token royalty and have everyone else sweating bullets because they knew that had copied my stuff. It was a good thing for Atari." - Nolan Bushnell

The final analysis of these early lawsuits shows that it really did not matter who invented "the video game", but it did matter who made it successful.

"I didn't invent the video game -- I commercialized it." [xxxviii] - Nolan Bushnell

---

1973: Innovative Leisure

Besides fighting copycats and legal battles in 1973, Atari continued to strengthen their engineering team, and create new games. At this point, creating games was almost entirely an engineering process. All the gameplay, graphics, and controls were governed by the TTL discreet logic and mechanical engineering skills of the technical team. For this reason, Atari continued to hire as many good technical people as possible. In June of 1973, Al Alcorn hired Steve Bristow to help create new games. Bristow was a fellow Ampex employee, and great engineer. He would stay at Atari for more than 10 years. Bristow and Alcorn, along with a couple of electrical engineers, set out with a directive from Bushnell to develop more games in vein of *Pong*. [xxxix]

However, while Bushnell concentrated on the engineers, the manufacturing process was in trouble. *Pong* games were breaking down, and customers were complaining that Atari's machines were not reliable. Part of this problem was that Atari was not able to pay enough money to its manufacturing staff.

"We were hiring people as fast as we could and paying them hippie wages, which was still above minimum wage. It was a situation where we were doing an awful lot of training" [xl] - Nolan Bushnell

Equipment "disappeared" from their facilities daily. They needed to make some kind of move to allay the fears of their customers.

To do this Atari created the "Durastress" trademark and began marketing their games as meeting "Military Specification 883" to their customers. "Military Specification 883" is defined by the Department Of Defense "Standard Test Methods and Procedures for Microelectronics", and was a requirement for defense contractors. While their arcade games might not have required this process, it sure looked good on their advertising and showed that Atari, at least in print, was trying to seem more reliable. To improve manufacturing, Atari hired outside experts and began giving benefits to their line staff that were almost unheard of at the time.

"...all employees received the same medical benefits as the executives" [xli] - Nolan Bushnell

At just about the same time, Atari created the first real slogan to describe their products:

"We define our product as innovative leisure. We will build the best products possible, and serve our markets in such a way that through time the Atari name is synonymous with: quality, imagination, research, after-sale service, and social responsibility."xlii - Nolan Bushnell

On July 16th, 1973 saw Atari second coin-op release, *Space Race*. It might not have been the complete innovation they needed, and while it was not exactly *Pong*, Atari made sure their customers knew it did not fall far from the tree.

"From The Originators Of Pong..." xliii - *Space Race* flyer

Space Race was designed by Al Alcorn as a two player-only timed game involving two ships flying towards the top of the screen. Players controlled the vertical position of the ships, and attempted to dodge asteroids to get to the top of the screen.. If they made it to the top, they received 1 point. The service manual has *"Pong"* scratched-out and *"Space Race"* written over it.*xliv* The machine is basically *Pong* with different TTL logic. Atari licensed the game to Bally/Midway under the name *Asteroid*.

Atari quickly followed-up *Space Race* with their second *Pong*-style game, *Pong Doubles*, in the Autumn of 1973. It was a 2-4 player version of *Pong* designed to stave off some of their growing competition.

"Atari's New Video Game. 2 Or 4 Players"xlv - *Pong Doubles* Flyer

---

1973: Partner's Split

By late 1973 the growing competition in the games manufacturing business made Nolan Bushnell's partner Ted Dabney very nervous. He decided to leave the company.

"We only had so much money and somewhere along the line he said 'let's split, I'll take the operations business' because at that time operations was making more money than manufacturing" - Nolan Bushnell

Bushnell was not immune to Dabney's fears, but he still believed in the arcade games business. But instead of quitting, Bushnell decided to expand the business. To do this he had to do something very creative. In October of 1973, Bushnell decided to grab as much market share as possible by signing exclusive contracts with distributors in each geographic area to buy only Atari games.

Because most geographic areas had two distributors, Bushnell separately (and semi-secretly) created Kee Games, named after Bushnell friend Joseph Keenan who became president of the company. Kee would sign exclusive contracts with the second distributor in a geographic area. The games that Kee and Atari produced individually were eventually released by both companies with unique names and some cosmetic differences. Steve Bristow went to work for Kee as their head of engineering.

"Joe Keenan was my next door neighbor. I told him, "I'd like to hire you to set up a company called Kee Games. We'll make it look like it's Kee for Keenan, and it will look like you've come in and started up a new coin-op manufacturer"xlvi - Nolan Bushnell

1973: *Pong* At One

After one year of operations, in November 1973, Atari had built and sold 6000 *Pong* machines, and sales were about $1,000,000 a month, with $15,000,000 in sales expected by the end of the fiscal year (June 1974). *xlvii* Even though there many competitors, Atari was still tried to push *Pong* in directions that the competition had never considered. Some of these ideas included prototypes, limited-run and unreleased versions of *Pong* such as *Pong In A Barrel*, *Doctor Pong*, and *Puppy Pong*. *xlviii*

At the same time, they worked on new ideas. The November AMOA show that year was quite different from 1972, when no one would give Atari's *Pong* a passing glance. This time, Atari generated much interest with a showing of *Pong Doubles*, and a new game, *Gotcha.*

"An Amazing Maze Of Fun! Another innovative winner from Atari, the leader in video skill games" [xlix] *- Gotcha* flyer

Gotcha showed that Atari's investment in engineering paid off. It was the first ever maze game, and featured a technical marvel for the time: an ever-changing maze. *Gotcha* was another 2-player game, featuring a scantily-clad woman chased by a man on the side of cabinet, suggesting sexual overtones that could not be conveyed by the rudimentary graphics of the time. *Gotcha* was another "simple to learn, difficult to master" game aimed at the bar crowd.

In December of 1973, Newsweek published an article that called Bushnell "King *Pong*". The name stuck for many years. Bushnell told the magazine (referring to *Pong*) "We've created a whole new market"[l] Players liked *Pong* because no luck is involved, and the more you played the more skillful you became. Bushnell described Atari's successful process for game design thus: "We have to walk a tightrope between reward and frustration".[li] At this time, Atari acquired one of their most infamous employees: Steve Jobs as was hired as a wiring technician by Al Alcorn.

Even with all their success, by the end of the year, more well-established competition was winning out. By the end of 1973, Midway has sold 9000 *Pong*-type machines opposed to Atari's 6000.[lii] Atari was now up against the big boys, and they weren't about to give Atari any credit for their inventions.

"The small companies will be in trouble when the crunch arrives" [liii] - 1973, Jack Mittel, Vice President of Sales for Williams Electronics

1974: More Of The Same

Atari started 1974 on a high note. *Pong* had sold well in '73, and they were creating new and innovative games almost every month. In January they released another *Pong* variant named *Superpong*.

"An Improvement On a Proven Money Maker From The Originators Of Pong*"* [liv] *- Superpong* Arcade Flyer

Superpong was a one or two player contest, an evolution over *Pong* that used variable ball speeds, angles, and three paddles (vertically aligned) for each player. To further spice-up the game, the ball was served from random positions on the screen. Atari described *Superpong* as "not easily mastered."[lv] In February, the first sign of Bushnell's Kee Games ploy arrived in the form of Atari's *Rebound*, and Kee's clone of it*, Spike.*

"It's A Whole New Ball Game" [lvi] *- Rebound* Arcade Flyer

Rebound was a simple game of volleyball -- in fact the Schematic dated 11/31/73 describes this game as "volleyball".[lvii] It's formed from a vertical version of *Pong* with simulated gravity. Hitting the ball would send it on a parabolic path over 4 short lines that represented a net.

"The Spike-Man Cometh... from Kee" [lviii] *- Spike* Arcade Flyer

Spike Was Kee's copy of Atari's *Rebound*. Kee's products were mostly copies of Atari's games with innovative features added to differentiate them from their Atari cousins, and create the feeling of a "rivalry" between the two companies. In this case, "the *Spike* button" was added.

March of 1974 brought another *Pong* variant named *Quadrapong. Quadrapong* was a distant cousin of the Atari coin-op to come, *Warlords*. The game featured 2-4-player action in table-top, look-down cabinet.

"Another Video Action Favorite! Quadrapong *is the newest addition to Atari's Line of unique video skill games." -* Quadrapong Arcade flyer

Each player was given four points, and tasked with defending one-side of a diamond-shaped screen. Players lose a point each time one of the others score in his goal, and is eliminated if this happens 4 times. At that point, their goal is sealed, and it becomes a solid wall. *Quadrapong* was actually an Atari copy of Kee game named *Elimination*.

1974: The Crunch Hits

While these variations on *Pong* were very interesting from a game design perspective, they were not as thrilling to the public or arcade operators are Atari had hoped. Sales were off, competition up, and Atari needed something new. Sensing the need for some serious innovative development away from the grind of company, Nolan Bushnell contracted with two ex-Ampex engineers, Steve Mayer and Larry Emmons at Cyan engineering, and created the Grass Valley Think Tank, an R&D lab for new Atari products.

The first project for the Grass Valley Think Tank was to finally create the racing game that Bally had contracted Atari created two years prior. However, this time the game would be for Atari itself, and Bushnell was hoping it would be a new direction away from *Pong*.

Grass Valley was tasked with creating an all-new cabinet and control mechanism for video games. Gone were the simple buttons and potentiometers used for control of *Pong* games, and instead there would be a steering wheels, gear-shift, gas, and brake pedals to give the game a realistic feel. It was a tough assignment, and for Grass Valley, it was a rough entry into designing video games. Al Alcorn had to step in and fixed the flawed design before it could be sold.

"We had built about 100 and they were badly engineered that they had to take them back. I came off of sabbatical and re-designed it."[lix] - Al Alcorn

Besides the innovative cabinet and controls, the game included realistic (for the time) sound effects, and, in addition to the TTL logic, used ROM memory in the form of diodes to store graphics information.

*"From the '*Pong *People', New video game concept, big racing action, fantastic sound effects, worldwide market in millions!" - Gran Trak 10* marketing flyer

The game is a race against the clock on a single track. There are no other cars on the track except the player. Oil slicks make the player's car spin-out. The side of the track had to be avoided. Besides all the costly rework and delays for the game, an accounting error had *Gran Trak 10* selling for $995, when it cost $1095 to manufacture[lx]. All of this led to the near financial collapse of the company. For the fiscal year of 1973-1974, Atari lost $500,000. *Pong* competition, *Gran Trak 10*, and a failed venture into Atari Japan[lxi] (sold off to Namco for $500,000) left the company near bankruptcy. Nolan Bushnell was forced to lay-off half of Atari's staff, and rethink his next moves.

1974: Corporate Retreats

In dire need of new ideas, Nolan Bushnell started taking his key engineers on corporate retreats to relax and come up with and innovative ideas. These were not simple marketing brainstorms, but "assisted" technical and game design discussions. These sessions started at the local Holiday Inn, but soon moved out to Grass Valley, and later into the hot tub at Nolan's house and into the one that he has installed in the engineering building.[lxii]

While these sessions were legendary for alcohol and marijuana consumption, those activities were not the focus. It was Bushnell's attempt to get his engineering team to come up with new ideas to save the company and move it forward. Most of the best game and product ideas game from these sessions, including coin-ops and consumer products such as the home version of *Pong*. They also solidified the notion that the "laid back engineer" ruled the day at Atari in these early years.

The effect of this brainstorming could be seen in the games that Atari produced thereafter. The second half of 1974 showed a marked difference in game design from the first. Atari started with a redesigned version of *Gran Trak 10* that fixed technical issues and added a second player. The game also offered the pinball-like feature of a free game for a high

score. *Gran Trak 20* featured two complete sets of controls (steering wheel, brake pedal, gas pedal, 4 speed gear shift) and offered operators more money per play (2 quarters for two players).

Double your pleasure... double your earnings! - Gran Trak 20 marketing flyer

The innovation continued into October with *Pin-Pong* -- a kind of pinball game with a patented "ball movement circuit".

"In Pin-Pong a gravity algorithm accelerates the ball downward to give realistic pinball action on the screen". - Pin-Pong marketing flyer

Atari finished out 1974 with two more games. One was their first light-gun game *Qwak!*, a duck hunting game that included a realistic-looking rifle, complete with an alarm that would sound if it was stolen -- plus the ability for the operator to set time limits, extended time and free games. The other was *Touch Me*, a screen-less coin-op game and precursor to the hand-held game Simon (incidentally created by Ralph Baer for Milton Bradley).

1974: The Rise Of Kee Games

While Atari continued to struggle, Kee games was operating at maximum efficiency. Joe Keenan, as it turned out, was not too bad at running an arcade games business. As well, Steve Bristow was designing up a storm. While Kee continued to copy Atari games (*Formula K* and *Twin Racer* were their answers to *Gran Trak 10* and *Gran Trak 20*), they also started to design a few games of their own.

One of their first was *Tank!*, and what a first it turned out to be! The game featured two tanks battling it out on the playfield filled geometric shaped barriers. It was the same type of game that Atari would make famous in their *Combat!* cartridge for the VCS three years later. Steve Bristow designed the game and Lyle Rains finished it. It was one of the first games to use actual ROM to store graphics.

"I was working on it when I hired Lyle then I gave it to him and he finished it. A lot of the implementation was his, but the original idea was mine."[lxiii] - Steve Bristow

The importance of *Tank!* in the history of Atari cannot be understated. It was the game that saved Atari from bankruptcy in 1974. The game became so popular that the exclusivity agreements Atari demanded from distributors were thrown out the window. Everybody wanted it, and Atari made sure they got it. Bushnell's cash flow problems at Atari were suddenly reversed. Atari and Kee merged at the end of 1974, and Joe Keenan became president of Atari, Steve Bristow became head of engineering and Al Alcorn became head of R&D. Atari was suddenly infused with new engineering and game design blood from Kee, like Lyle Rains. Nolan Bushnell also moved into a new role.

"I really became the CEO. I was still doing what I call game producing, but I was not doing any of the design. We would sit down in creative sessions and I would pretty much decide which games we would be doing, but I became less and less involved in the actual engineering." - Nolan Bushnell

Atari ended 1974 on the same high they had just one year earlier. They had surmounted their cash flow problems and cemented engineering and game design as the most important parts of the company.

1975: Innovate Or Die

With his newly fully-realized company, Bushnell was firing on all cylinders. The parties and game design sessions continued, and Atari started getting reputation as the place to "work hard and party harder". As the engineering group grew in size and importance, it got the reputation of being a very informal and laid-back place to work.

About this time, Nolan Bushnell created a manifesto that described their business. Bushnell was pushing to define Atari's place in the entertainment world.

"We define our product as innovative leisure. We will build the best products possible, and serve our markets in such a way that through time the Atari name is synonymous with: quality, imagination, research, after-sale service, and social responsibility." - Nolan Bushnell's Atari Manifesto

The manifesto also described Bushnell's ideas for the ideal workplace:

"A corporation is simply people banding together in an organized fashion to produce products or accomplishments which would not be possible otherwise. When the goals of Atari and the goals of its people are in harmony, Atari is strong and its people are happy and satisfied." - Nolan Bushnell's Atari Manifesto

It went on to describe a couple ways people would be treated:

"Maintain a social atmosphere where we can be friends and comrades apart from the organizational hierarchy. Encourage and promote personal growth through education and training such as that we may all reach our individual potentialities." - Nolan Bushnell's Atari Manifesto

However, if it seemed like a fun place to work, Atari was also a very difficult job. For instance, while there were no set hours, you had to make games well or get out. There was little room for time wasters or people who were not interested in making games, and making them well.[lxiv]

"Atari's strategy was actually quite simple and, I think, quite elegant. We were known as a party place, but the important thing is that parties didn't happen unless quotas were made. We had a lot of parties because people made their numbers." [lxv] - Nolan Bushnell

1975: Coin-Op Division

The coin-operated games that Atari produced in 1975 built on the success of *Tank!* And the strides in innovation they had made the previous year. Since the success of *Tank!* had brought more people into the arcades and proved that more than *Pong* could be successful, it was easier to sell more and different types of games. While there still were a couple *Pong*-style games (i.e. *Goal IV*), and the odd R&D offshoot (Compugraph Photo Machine) many were *Tank!*-inspired military concepts.

In January Atari released *Pursuit,* a WWI game in which you shoot down enemy planes in your crosshairs. Later that year came *Anti-Aircraft*, which played much like the VCS launch title *Air Sea Battle* that would appear two years later (it also included an undocumented switch that could turn the planes into UFOs[lxvi]). Still later, in October 1975 came *Jet Fighter*, another game that would see its home debut two years later on the VCS *Combat* cartridge.

"Atari's Jet Fighter is a video action game in which players pilot two airplanes across the sky in a fast-moving duel."- *Jet Fighter* marketing flyer

Throughout the year, new versions of *Tank!* arrived as well, including *Tank 2*, *Tank III,* and a cocktail table version of the original *Tank*. *Tank 2* added land mines represented by X's.

Throughout 1975, Atari continued producing racing games. One of the first of the year was in March with *Hi-Way*, a sit-down cockpit-style driving game, the first with a scrolling playfield that Atari patented (and perpetuated) for many years. They also continued to produce the single screen, multiplayer racing games that they invented with *Gran Trak 20*, but now allowing many more people to play once.

New 8 Player version of the greatest money-maker ever! - Indy 800 marketing flyer

Indy 800 was an 8-player racing game with a full-color screen. An optional control module allowed an official "starter" to facilitate tournaments. The game included a mirrored canopy to allow spectators to view the racing action, and even equipped each driver with their own horn. The entire cabinet took up 16 square feet of space.

Another multi-player racing game was released in October 1975 with *Steeplechase*. This time the theme was horse racing, and the game could be played by as many as 6 people at once. Atari also tried its hand at a demolition derby style game with *Crash 'n Score* in October of 1975.

"Atari's Crash 'n Score *is a video action game in which one or two players drive race cars on a rectangular playfield and earn score points by driving through lighted score flags. During play a player has to maneuver his car around certain obstacles and has to avoid the opponent car."*
- Crash 'n Score service manual

Atari's most notorious coin-op game from 1975 was probably *Shark Jaws*. *Shark Jaws* was a one player game designed to capitalize on the movie Jaws. Legend has it that Atari tried to secure the rights to the movie Jaws, but failed. Instead of jeopardizing Atari, Bushnell created "Horror Games" specifically for this game, and released it anyway. The game was very simple, consisting of a swimmer, fish, and shark. The swimmer had to catch the fish, without being eaten by the shark.

"Atari had a real crude attitude about things. Jaws was such a big movie and we decided we would do a game that was sharks eating people. We decided we would do it under the nom de plum of 'Horror Games'. Shark Jaws *was actually a huge success, we sold a couple thousand."*[lxvii] - Nolan Bushnell

---

1975: Home *Pong*

At one of the Grass Valley retreats, when Atari was struggling in 1974, the subject of a home version of *Pong* was brought up to Nolan Bushnell by engineer Bob Brown. Fellow engineer Harold Lee and Bob Brown had been bouncing the idea around as far back as 1973, but at the time it did not amount to a serious discussion. However, with Atari on the brink of financial disaster in '74, the time seemed right to investigate the possibility once more. To make a home version of *Pong* viable required that the entire game be placed on a single microchip. Up until that point, Atari had never used microchips in its products, so it was a huge step for them to attempt to enter that arena.

"I got to talking about Pong *with an engineer friend of mine named Harold Lee, who was working in coin-op. I really wanted to do a consumer product so I asked him whether we could put* Pong *on a chip. It would be a dedicated home game for TV that would essentially be like the coin-op* Pong*. He said it could be done, and then we sold Atari on the idea."*[lxviii]- Bob Brown

By the fall of 1974, Al Alcorn had joined Harold Lee and Bob Brown, working on a home version of *Pong*, now code named "Darlene". Discussions at the Grass Valley retreats tended to move into two directions: technology and women. It just so happened that when Home *Pong* was discussed, so was a particularly attractive Atari employee named Darlene. The name stuck, and so did the trend of Atari to use female names as code words for their most secret of projects.

"We were all young, it was the '70s, it seemed like the right thing to do."[lxix] - Nolan Bushnell

By early 1975, the success of *Tank!* left Atari in a good position to start to seriously work on home *Pong*. They earned $3.5 million on $39 million in sales for fiscal 1974-1975, and could afford new R&D. The cost of microchips had come down to a level that would make the project economically viable, so Atari decided it is the time to go full-bore and enter the home market. Even though Bushnell was urged by advisors to stay away from the home market (the same one that Magnavox was struggling in), he decided to do it anyway.

"The next epiphany, if you would, was when we figured out we could put Pong *on a single LSI chip... All of a sudden, we knew we could put one in every home. All of a sudden, we went from a very successful coin-op business to a potential consumer business."* [lxx] - Nolan Bushnell

Alcorn, Lee and Brown worked through 1974 and into 1975 perfecting a microchip-based home Pong unit that could not

be easily copied by the competition. By mid-1975, they had succeeded, but then had no idea what to do next. Atari had never marketed anything to the public before. Most of their previous marketing materials consisted of flyers sent out to amusement operators to announce their new games. Gene Lipkin, their VP of marketing, had experience in the coin-op world, but this was very new to him. What was good enough for a company based on engineering and game design that sold to a limited audience for $1,000 or more per unit would never work in the high-volume, low-margin world of consumer goods.

Atari took Home *Pong* to industry trade shows like the New York Toy Fair, directly to toy stores, and offered it to various departments at Sears (toys, appliances) but all refused. The only person even remotely interested was Tom Quinn, who managed the buying for the the Sporting Goods department at Sears. He initially ordered 50,000 units which increased to 150,000 by Christmas. It was the perfect way to start. If any company had experience in consumer goods it was Sears and Roebuck, then the largest consumer goods retailer in the country.

Aside from a lack of marketing experience, Atari also had no experience manufacturing consumer goods in the amount required to service a huge account like Sears. New facilities had to be created, processes put in place, employees and hired. To make their Sears quota Bushnell enlisted the aid of Donald Valentine to help secure venture capital for Atari. He came through with $600,000 in the summer of 1975, and another $300,000 in December, which was enough to help get the home *Pong* manufactured.

The home *Pong* unit (sold under the Sears Tele-Games label) was a huge seller in the Christmas 1975 season. The gamble paid off -- Atari was now a technology leader in two separate markets, arcade and home, something no one had ever done before.

"We risked the company every year on new ideas. We were young and if it failed we could always get jobs in Silicon Valley"[lxxi] - Al Alcorn

---

1976: Coin-Op Business

Coming off the success of home *Pong*, Atari did not rest on its coin-op laurels. It started the year releasing more games based on TTL discreet logic. The first came in February with *Stunt Cycle*.

"Now the people who brought motor sports racing to a video track brings your customers a fantastic motorcycle jump and stunt attraction." - *Stunt Cycle* marketing flyer

The action in *Stunt Cycle* was influenced by the then reigning king of motorcycle jumping and crushed pelvic bones, Evel Knievel. Much like *Shark Jaws* though, inspiration was enough -- no license was acquired. The cabinet included realistic motorcycle handlebars, and a handle-grip throttle.

Stunt Cycle was followed by *Quiz Show* and *Indy 400* (a cheaper, smaller 4-player version of *Indy 800*) in April, and the racer *LeMans* in July. However, it was the March release of *Outlaw* that was more significant... for the wrong reasons.

Inspired by the success of Midway's *Gun Fight* from 1975 (the first game to use a microprocessor), *Outlaw* was a discreet logic TTL game, and the technology was showing its age. The difference between the sharp graphics from *Gun Fight*, and the blocky designs of *Outlaw* were unmistakable. And while the two-player action in *Gun Fight* was thrilling, *Outlaw*'s simple quick-draw seemed ancient by comparison. Atari's game looked behind the times, and they needed to act fast. Atari engineering was already working on games that used 8-bit microprocessors, but before any were released, the last and greatest TTL discreet logic game would take the arcade by storm.

"Nolan Bushnell wanted a game that was like a single player Pong *with bricks that you would hit and the ball would go behind them"[lxxii]* - Steve Wozniak

Atari's *Breakout* coin-op was released in May of 1976, and it was an instant classic. Designed by Nolan Bushnell, the game was engineered by Steve Wozniak in a 4-day challenge to see how few TTL chips could be used to create a fully functioning game. Wozniak's forte was designing systems with as few chips as possible. His friend, Steve Jobs, had been working as a technician at Atari for a few years, and asked Wozniak to see if he could design a game with as few parts as possible. There was incentive, in the form of bonuses for Jobs -- who shared part of it, but not all, with Wozniak -- but also incentive on Atari's part to move away from cumbersome designs that used hundreds of TTL chips.

"The reason Atari wanted me to design it is they were tired of their games taking 150, 200 chips, and they knew I designed things with very few chips, so we had incentives for getting it under 50 or under 40 chips."[lxxiii] - Steve Wozniak

The final design used 46 TTL chips, and was so intricately created that it had to be sent to Grass Valley to be re-engineered for manufacture.

"The design was so minimized that normal mere mortals couldn't figure it out."[lxxiv] - Al Alcorn

Breakout generated sales of over 11,000 units priced at $1095 each.[lxxv] However, it did more than just that. It made people want to go back to the arcade. The game was also a worldwide success. Atari sold the Japanese rights to their old partner, Namco. Since supplies were so low, Atari could not get enough units to Namco, so the company made their own knock-off (everyone else was doing the same) and it helped make them a huge player in the Japanese game industry.[lxxvi]

Even though *Breakout* was a huge success, and showed how few TTL chips could be used to create a great game, the days of discreet logic design were nearly over. 8-bit microprocessors had come down in price to the point where they were a feasible alternative, and could provide much more power with a standardized architecture. The first two chips Atari engineers used were the MOS 6502 and the Motorola 6800. Plus, there were things that you could do with microprocessor that were nearly impossible with a TTL logic design. A.I. , for example, was so difficult to recreate with discreet logic, that Atari's games had continued to increase the amount of human players they could support to compensate, and in turn increased the games' size and cost, while decreasing the ability for an amusement operator to buy them or find space to display them.

Developing a microprocessor-based game was much different than designing one with only TTL chips. Most of the early microprocessor-based gamed were hybrids of TTL and microprocessor, and it made the job that much harder. Owen R. Rubin was one of a new breed of coin-op designers hired around 1976 to help move Atari into the microprocessor age. His first game, the unreleased *Cannonball,* was one of Atari's initial forays into microprocessor based games.

"The hardware was rather simple. You have a number of 'motion objects' which could be placed anywhere on the screen. Early version simply took graphics from a PROM and the programmer simply set a value in a register to select which picture. There were missile graphics, 2x2 or 1x1 objects to use as bullets. The playfield was a "stamp" based graphics made up of 8x8 or 16x16 graphic stamps that were also pulled from a PROM."[lxxvii] - Owen R. Rubin

The power of microprocessor-based hardware could be seen almost immediately. *Cops 'N Robbers*, released in July, was essentially a modernized version of *Gun Fight*. Two very detailed cars were controlled by the players as they attempted to shoot each other across a roadway.

"New programming and electronic design give the players more action, movement, and larger, more animated figures" - *Cops 'N Robbers* marketing flyer

Fly Ball, a two player baseball style game (more "over the line" than baseball actually) featured animated players of a kind Atari had never produced up to that point. *Sprint 2,* released in November, was a major update on the *Gran Trak*-style game. It included multiple tracks, on-screen text, and for the first time, A.I. cars to compete against the player.

"A solo driver sprints against the clock in a white car, but he is not alone. He competes against a black car and two grey cars that drive automatically."- *Sprint 2* marketing flyer

Arcade operators saw $200 - $300 a week from the machine.

"Sprint 2 is earning extremely well... we feel it will surpass many of the other video games" - Ray Galante of Music Vend Seattle in Coin Connection Feb. 1977

Sprint 2 went on to became a huge hit, selling more than 8200 units[lxxviii], and spawning multiple sequels.

Also a success was an update of *Tank!* for 8 players named appropriately enough, *Tank 8*. However, it was the October release of *Night Driver* that really showed the power of the microprocessor. One of the very first games viewed from a first-person, 3D perspective, the game was designed by Dave Shepperd. It featured a winding road at "night" (you could only see white dots that represented the side of road) that needed to be traversed by the player.

"I have fond memories of spending time watching the white lines in the street and fence posts whiz by my car as I drove to and from work, trying to work out in my mind's eye what kind of math I can use to make little squares on a TV kind of do the same thing."[lxxix] - Dave Shepperd

The game was a sizable hit for Atari, and it proved that advanced technology could not only improve video games, but could open up new styles of play that were once nearly thought to be impossible to produce.

1976: The Home Front

Even with successful coin-ops using new technology, Atari was still finding the competition for arcade floor space suffocating. With a $250,000 cost to develop a game, and about 10% chance it would be successful, Atari had to become serious about their second front: the home.

However, that would not be easy. After being successful in 1975 and early 1976 with home *Pong*, sold through Sears, Atari created more versions of home *Pong* to market both themselves and through Sears including C-140 *Super Pong*, C-160 *Pong Doubles*, C-180 *Super Pong Ten*. However, by that time, Atari was not the only company selling a chip-based *Pong* unit. At least 75 companies announced their intentions to get into the business in early 1976. Atari might have made the first home *Pong*, but just like its experience with their coin-op *Pong*, dozens of imitators were in pursuit of the same dollars. Atari tried to combat the imitators by generating a sense of loyalty in consumers to buy "A Real Atari", but compared to some of the newer models, Atari's home units looked primitive just 6 months after they went on sale.

In early 1976, General Instrument created the AY38500 microchip that included 6 paddle and shooting games in one unit. Coleco was the first buyer of the chip, producing the Telstar Arcade, an impressive-looking console that was competitively priced with Atari's *Pong*.

Worse for Atari, in the summer of 1976 came the Fairchild Channel F system, the first console that used interchangeable games on cartridge. The Channel F was never a huge seller, but, coupled with the Christmas best-seller Coleco Telstar, these moves rendered Atari's dedicated home business almost worthless in less than a year.

1976: The Apple Mistake

With the focus on home video games and coin-ops, Atari did make one move in 1976 that, in hind-sight, could have been their biggest mistake. Steve Jobs, who had left Atari and was working for HP at the time, brought a piece of equipment to Al Alcorn that he and Steve Wozniak had been working on in their garage. It was a computer based on the same MOS 6502 processor that Atari had started using in their coin-op games. Alcorn thought it was a "neat engineering project" but did not think it was right for Atari.

"we said 'no thank you'…but I liked him, I thought he was a nice guy, so I introduced him to venture capitalists"[lxxx] - Al Alcorn

Atari did not have the resources enter a third, unproven market. They let the opportunity go. The machine became the Apple I computer, and rest is history for Jobs and Wozniak. Atari learned to regret this mistake as they tried to enter the home computer market a few years later.

1976: Building The 2600

Bushnell was convinced that Atari needed to outthink their competitors -- and could. The 1975 hit coin-ops *Tank!* and *Jet Fighter* were suggested as dedicated follow-ups to the *Pong* units, but Atari was tired of designing and selling dedicated hardware that cost $100,000 to develop[lxxxi] with only two to three months of shelf-life before it became outdated. The company needed to design a platform that could sustain a life of two or three years, and at the same time support incremental game sales to an already established user-base. Months before the Fairchild Channel F appeared on store shelves, Atari was well on its way to creating a similar, yet much more flexible system.

The R&D team at the Grass Valley Think Tank started working on ideas for a programmable unit that could use interchangeable games as early as mid-1975. The problem was, most suitable microprocessors, like the Motorola 6800, cost $100 each. This was too much for a consumer product. In September 1975, Steve Mayer and Ron Milner met Chuck Peddle (who had recently left Motorola) at Wescon and made a deal to buy his microprocessors (MOS 6502) for $8 apiece. The 6502 met the minimum specs required for the reprogrammable system they were planning to create, and could also be used as the basis for microprocessor based coin-ops.

In December 1975 Atari R&D at Grass Valley hired Joe Decuir, and one of his first projects was to help debug a piece of hardware that would become the Atari VCS console.

"Steve Mayer and Ron Milner conceived of the VCS, and designed the first prototype of its ancestor."[lxxxii] - Joe Decuir

Soon, the VCS project attained the name "Stella", named after Decuir's bicycle. The first programmable system prototype used controllers from Kee's Tank coin-op, the custom Stella chip, a 6502 hobbyist board, and a 5 volt power supply[lxxxiii].

A second prototype was developed in Los Gatos in March 1976[lxxxiv], as Joe Decuir worked as an apprentice to Jay Miner, a legendary Silicon Valley hardware designer, and the only person Al Acorn knew of who could pull off the project. They set out to create a machine whose inner workings were accessible to the programmer, and could be exploited by those who got to know the hardware well.

Work on the VCS took place in Grass Valley, and in Los Gatos, California.

"In March of 1976 I moved to Los Gatos CA to apprentice for Jay Miner, the lead chip designer."[lxxxv] - Joe Decuir

There, Jay Miner and his team designed the guts of the Stella. This included the 6507 processor, TIA sound chip, cartridge slot and controllers. For most of the team, the project was thrilling.

"I would bicycle to work and back marveling that I was getting paid to do this."[lxxxvi] - Joe Decuir

In the fall of 1976, Atari showed how serious they were about this new "programmable console", so much so that they bought out the Grass Valley Think Tank ouright, and moved the entire development team to Atari's new headquarters in Sunnyvale, California. They incorporated the team into Atari's R&D staff, and Steve Mayer led the team.

We had to wait until we got to the 6502 or the 6800 series before there was even a possibility. Even then, they were too slow. We had to develop the Stella chip... which basically did all the screen refresh and other things that have to happen in real time, much faster than a microprocessor running at 300KHz could possibly do." [lxxxvii] - Nolan Bushnell

It was at this point that Nolan Bushnell pulled off one of the most brilliant moves of his already brilliant career. Since Atari had been beaten by their competition at their own game more than once, he decided to head them off at the pass. Instead of waiting for competitors to emerge after the Stella project was released, he decided to tie-up all available chip fabricators that could possible make a similar piece of silicon. It would not matter if someone tried to copy Atari -- because this time they would not be able to get any chips produced.

"I always played business as a game. What a lot of people don't realize is that I tied-up every N-Channel manufacturer in the world, except for IBM, who had no interest in the game business. In those days when you built with slight modifications to tie them up. I wanted to have everybody working for me contractually. They did not necessarily know about one another."[lxxxviii] - Nolan Bushnell

However, these projects were very costly, to the tune of $100,000 each per year. To finish the Stella project, Atari needed an infusion of cash. They had finished fiscal 1975-1976 with $3.5 Million profit on $39 million in sales, but with growing competition, Bushnell did not think they would have enough money to finish the project.

"When you're a little company, and you hear that National Semiconductor is going to build a game and that Magnavox is going to build a game, then all of a sudden you say, I'm this little tiny ... do I have the resources?" You don't realize at that time that big companies tend to be really screwed up, so that they're sometimes really easier to beat than a good, well-tuned entrepreneurial operation." [lxxxix] - Nolan Bushnell

In the summer of 1976, Nolan Bushnell enlisted Donald Valentine again to help raise capital for the company. This time though, Valentine suggested Bushnell try to find someone to buy them out.

"What happened is a growing business consumes capital at prodigious rates. And Wall Street had a hard time distinguishing between the frivolity of our product and the fact that it was a serious business. Raising capital was very, very difficult for us. In order to go into the consumer marketplace, we just needed much deeper pockets, and that's why we decided to sell."[xc] - Nolan Bushnell

About the same time Manny Gerard was hired by Warner Communications to look for ways to expand the business. They wanted key acquisitions that would help the company move beyond its reliance on selling 7" singles, a product line that had been declining for a number of years. He heard about Atari being offered for sale, and was very interested.

While negotiations are being held, Bushnell tried to keep the true "laid-back" nature of the company away from the Warner executives who he as sure would frown upon Atari's liberal attitude toward dress and drug use. One story says that right before a surprise visit from a Warner executive, Bushnell had all the assembly line employees hide inside game cabinets for 45 minutes, so as not be seen by the Warner visitors.[xci]

However, no insurmountable roadblocks appeared, and by November of 1976, Atari was sold for $28 million dollars, with Bushnell himself pocketing nearly $15 million, and Joe Keenan a sizeable sum as well. Warner was smart enough to see something special in Bushnell, and they kept him on as Chairman and CEO, while Joe Keenan acted as president. $100 million was pumped into Atari, and Stella was put into the forefront as the company's most important project.

In a matter of a few months, one of the greatest R&D and entertainment engineering companies of its day was suddenly matched with a one of the biggest entertainment marketing companies on earth. At the beginning, it seemed like a good marriage.

"...we had originally made a grocery list of 10 companies we would be willing to merge Atari with and Warner was not on that list. But through a connection, we made contact with Warner. We were really impressed with them, and I think they liked what they saw." [xcii] - Gene Lipkin, Atari V.P. Of Marketing

The "creative" atmosphere that Bushnell fostered at Atari seemed like it would match well with a company that saw much of its revenue from the music business. If the two could find a way to stay in sync, they could prove to be an unstoppable force.

1977 Coin-ops

With all the drama on the consumer side, the coin-op division of Atari sailed into 1977 building off of *Breakout* and its successful microprocessor advances from 1976. The infusion of marketing people from Warner had an almost instant effect, as the coin division launched a monthly newsletter named "Atari Coin Connection". This monthly newsletter would act as Atari's official mouthpiece to amusement operators for game announcements, promotions, etc. The downside to the influx of new marketing people into Atari was that some creative freedom got lost in the process. The days of batting around games in a hot tub that were quickly green-lit and put into production were over. Fierce brainstorming sessions still existed, but the days of engineering and R&D leading the charge at Atari were quickly evaporating, with the newly bolstered marketing department filling the void. Coin-op designers like Owen R. Rubin would come up with ideas that were quickly shot down by the V.P. of marketing.

"It happened so often, that we would have the hardware engineer add a button under the table that would cause the hardware to crash, so when the VP came into the lab, we could not show him them game. That only worked for a while." [xciii] - Owen R. Rubin


For the most part, the coin-ops of 1977 took few chances and built on already established concepts. Racing contests continued to fill up much of Atari's 1977 coin-up lineup. *Sprint 4* and *Sprint 8* (4 and 8 players respectively) were multiplayer follow-ups to phenomenally successful *Sprint 2* microprocessor-based racing game from 1976, which itself was a distant cousin of *Gran Trak 10*. However, the new power of the microprocessor-based coin-ops allowed Atari's coin-op division to move into other types of racing games. In June they released *Drag Race*, which allowed one or two players too complete in a side-view drag race, complete with detailed, animated cars. September saw the release of *Super Bug*, designed by Howard Delman, a top-down, multi-directional scrolling racing game.

"Super Bug was my first coin-operated video game. It presented a top down view of a city street. (Its original name was 'City Driver'.*) The player had a fixed amount of time to drive his bright yellow 'bug' as far as he could. Obviously, the idea was to drive as fast as possible. This was made difficult by sudden turns in the road, surprise oil slicks, sand traps, and parked cars."* - Howard Delman [xciv]

Beyond racing games, Atari was trying to design a multitude of other games based co concepts that could not have been easily created in the pure TTL logic era. *Dominoes* (designed by Dennis Koble) released in January, took the concept of Gremlin's *Blockade* coin-op and added a Domino theme. *Pool Shark*, released in
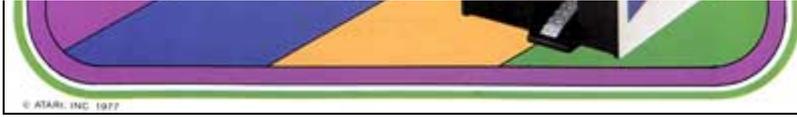
June, played a top-down game of pool, complete with realistic physics.

"Pool Shark *is an Atari game that simulates the game of Pocket Pool (no pun intended) on 23" monitor."* - Actual introduction from *Pool Shark* operations and service manual

The concentration on military themed coin-ops continued unabated as well, with *Destroyer* in September, another game that would be mined for the VCS game *Air-Sea Battle* later that year (along with *Anti-Aircraft* from '76). More significant was *Canyon Bomber*, released in November. A strikingly different game from most in the arcade, *Canyon Bomber* took the basic concept of *Breakout*, and turned it on its head.

"As the aircraft fly over the canyon at random speeds, players press a simple push-button control to bomb as many targets as possible without missing"- Canyon Bomber marketing flyer

Canyon Bomber was another game by Howard Delman, one of the new crop of coin-op designers who helped bridge the gap between the TTL games of old and the new microprocessor-based games.

"I designed the hardware and wrote the software. The logic was still all TTL, but now the micropressor was the MOSTEK 6502. I wrote the code in assembly, and won a friendly bet with my supervisor by fitting the code into a single 2K ROM. (Take THAT Windows programers!)"[xcv] - Howard Delman

Not quite military, but a gun-based game nonetheless, *Triple Hunt,* designed by Owen R. Rubin, was significant in that it was a single arcade game that could be converted into three separate light-gun games: *Hit The Bear*, *Witch Hunt*, and *Raccoon Hunt.*

However, one of the best selling games (3500 units[xcvi]) for Atari in 1977 came in June: *Starship 1*.

''*Sensors detect another quarter in your pocket, deposit it to be the captain of* Starship 1'' - *Starship 1* message on attract screen [xcvii]

Starship 1 was a space combat game that used 3D perspective, and space ships that looked remarkably similar to those from Star Trek. It was obvious though, that the mammoth success of Star Wars, released in the movie theaters just a month earlier, had an effect on the timing of *Starship 1*, as the game included "proton torpedoes", and allowed the player to destroy entire planets.

1977 Atari Pinball Division

Even though Atari had been making coin-op video games for 3 years, the industry itself was at a crossroads in 1975. The average video game was only making about $43 a week, which was far less than a pool table could make in the same period, and much less than the first *Pong* machines made.[xcviii] Amusement operators were getting nervous, and Atari decided to try its hand at an age-old staple of the arcade: the pinball machine.

"I got in because I felt there was a market for a novelty pinball. There was a lot of innovation that pinball needed and in those days in the coin-op world you really wanted to be a full-service supplier. There were places that just wanted pinball, period. We knew that we had such a large market-share of video, so we felt that it would make sense to do pinball."[xcix] - Nolan Bushnell

However, Atari did not want to just make typical pinball machines. In 1975 Atari created its Pinball Division with the hope of using the type of innovation it put into their video games for new and different types of pinball machines. Atari needed to do this, because the margins on standard pinball games were very low. If Atari was going to get into pinball, it would have to price their games higher than the competition, and to do this, it needed to offer something different.

"So we had about $100 cost differential and the pinball machines in those days were kind of commodity priced. I felt we could make a business, but we could not do a commodity pinball, one that looked like it was the same size, so we created these wide bodies and these various other innovations which allowed us to price them anywhere we wanted to" [c] - Nolan Bushnell

After merging with Kee in '75, Gil Williams (who had "left" Atari with Steve Bristow to help form Kee in the first place) was put in charge of the new Pinball Division. The first decision was to make the games "solid state". This meant that they would use electronics instead of the electromechanical parts of standard pinball machines. This meant they would be cheaper to maintain, and offer video-game like features such as digital sound effects. Starting with five employees, Williams set out to create the best solid-state pinball games ever produced.

"You need steel balls to play Atari pins."[ci] - Gil Williams

Atari's first solid-state pinball game, *The Atarians,* was finished and test-marketed in late 1976, after nearly 2 years in development. Besides a solid-state design -- like all Atari pinball games, *The Atarians* utilized a Motorola 6800 processor -- it included a wide-body with a much larger playfield than standard pinball machines, and ball sensors under the playfield instead of switches.[cii]

"The Atarians *introduces a new generation of advanced coin operated amusement products. Two years of research, planning and development and an extensive field-test program has verified strong player acceptance of the game."* - The Atarians marketing flyer

The game was released in February 1977 to early success. Early tests of *The Atarians* showed that the game drew players who usually did not play pinball games. The Atari name was now known by the arcade-going public, and they were eager to what Atari had to offer in the pinball arena. In December 1977, Replay magazine cited Atari's entry into the pinball arena as "clear proof that pinball is the industry's number one favorite."[ciii]

Two more pinball machines were released in 1977 -- *Time 2000* in September, and *Airborne Avenger* in October. *Airborne Avenger* had a playfield designed by Steve Ritchie, who would go on to design the legendary *Black Knight* for Williams, and was programmed by Eugene Jarvis (creator of the *Defender* and *Stargate* video games for Williams).

1977: Chuck E. Cheese

One of the more interesting ideas spawned by the engineer entertainers of Bushnell's Atari was The Chuck E. Cheese's Pizza Time Theater. The idea was spawned in about 1974 when Atari was having trouble getting games placed in the limited arcade space of the day. In an attempt to appeal to families, Atari came up with the idea of a pizza restaurant with animatronic animals, and as large an arcade as they could build. While families waited for their pizza, they could play Atari's video games. The concept took a very long time to establish into an actual business. It was not until May 16th, 1977 that the first Pizza Time Theater made its debut in San Jose.

"The grand opening on May 16th was a great success. Mayor Janet Gray Hayes, together with many other prominent people from the community and the press, came to welcome Chuck E. Cheese and the Pizza Time Theatre to San Jose. This new concept in family entertainment is another amusement innovation from Atari." - Coin Connection, June 1977

The restaurant was filled with animatronic figures developed originally at the Grass Valley Think Tank. Besides Chuck E Cheese, they created Crusty the Cat, Jasper T. Jowels the singing dog, Pasqually the Italian chef, and a team of three singing magpies known as the Warblettes.

The brass at Warner Communications looked the other way over Chuck E. Cheese because it kept Bushnell busy as they went about discovering all the ins and out of the new company they had acquired.

"They sort of tolerated it but they figured it was going to be something that would go away. They didn't understand it." [civ] - Nolan Bushnell

1977 The Home Division

Besides continuing work on Stella, Atari's Home Division released several products in 1977. The most interesting was named Atari Video Music. Video music was designed by designed by Bob Brown, and reportedly, conceived during one the Bushnell's infamous offsite "retreats".

"Bob Brown had designed Video Music, our weirdest product ever. Hook it up to your stereo and TV at the same time, and the sound triggered some pretty psychedelic visuals. The Sears guys took one look and asked what we'd been smoking when we did that. Naturally, one of our techs lit up a joint and showed them." [CV] - Al Alcorn

The unit was designed to be stacked with other stereo components. RCA audio-in jacks would take a music feed, and then output a graphical pattern to a TV screen. There were multiple patterns, and they animated according to the audio spectrum of the particular song being played.

"We feel that Video Music will add excitement to the audio market." [CVI] - Kerry Crosson, Atari's manager of new consumer products

The unit made its debut at the January 1977 CES show, but never struck a chord with the public. It was sold for about year and then discontinued.

Even though the Stella project was in full swing, several dedicated home game units were released in 1977, including *Super Pong Pro-Am* (C-200), *Super Pong Pro-Am Ten* (C-202), *Ultra Pong* (C-402(S)), and *Ultra Pong Doubles* (C-402(D)). They also created some unique consoles that played home games other than *Pong,* including *Video Pinball* (C-380) and *Stunt Cycle* (C-450). Sears released many of these units under their own naming scheme.[cvii]

1977 was pretty much the end of these types of units for Atari. Rumors have it that some time in 1978, Atari had so many dedicated game units left unsold, that they were just going to throw them away. Instead, they took them outside their warehouse on Borregas Street, ran them over with a semi cab, and threw them into dumpsters so no one could reuse them.[cviii]

1977 Video Computer System

The most important project at Atari in 1977 was the interchangeable games console, Stella. The final version of "Stella", now renamed by marketing as the Atari Video Computer System (VCS) contained the following:

- 6507 processor (6502 derivative) running at 1.2 MHZ
- 128 bytes of RAM, 4K bytes of ROM addressable on cartridges
- TIA custom video and audio chip
- 6532 timer
- Two controller ports that could support 8-way joysticks with a fire button, potentiometer-based paddles, driving controllers, or keypads

The target was to support *Pong* and *Tank!*-style games. For this they included 2 8-bit "player" objects, and 3 1-bit "ball" objects plus a low-resolution playfield supported in hardware.

With the millions of dollars Warner poured into the company, Atari was able to attract some of the best engineering talent around to make games for the system. Atari put an ad out to hire programmers for the their new machine. Larry Kaplan was one of the first to get hired, along with Alan Miller, Larry Wagner and Ed Riddle.

"I saw their ad in the Mercury News and applied for the job. I was among 100 applicants and Bob Brown later told me they hired me because I had purchased an Altair 8800 (the first home computer kit."[cix] - Larry
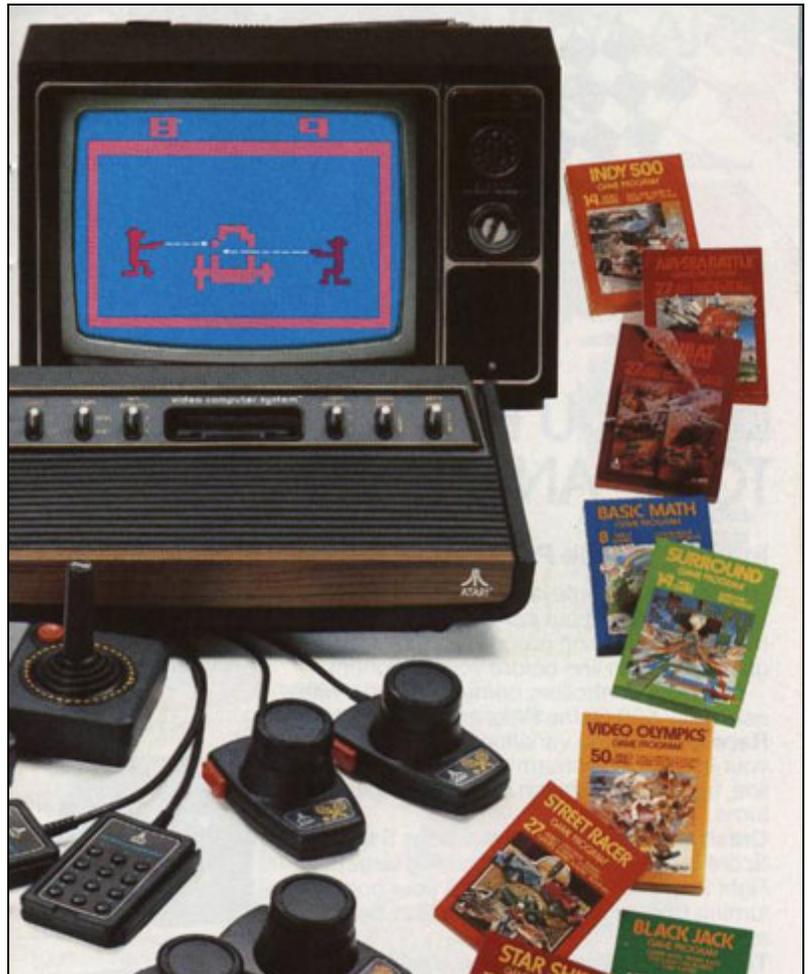
Kaplan

All the new programmers soon learned how difficult
Stella was to program. Programmers had to learn the
quirks of the VCS to get as much power out of it as
possible. There were few objects to work with, and and
very little memory, so everything had to be done on the fly. A typical game would use the "Vertical Blank" (the time
between refreshes of the TV screen display) to do collision detection, take input, compute game conditions and new
graphics locations, and then use the "Horizontal Blank" to write everything to screen.[cx] It was a complicated process that
forced programmers to count the computation cycles of every instruction to make sure they could fit their code into these
small intervals.

*"Writing the kernels that make up the game programs, is like solving acrostic puzzles with lots and lots of possibilities.
There's a certain class of programmer that can deal in the microcode like that. If it were easier to program, we wouldn't
have these programmers, because they'd be bored. The VCS is an absolute challenge."* [cxi] - Steve Mayer

*"In the early days, the extreme hardware constraints eliminated most obvious game designs. So, game concepts had to
be developed with those constraints expressly in mind. After I came up with a concept that I thought would be fun and
could be implemented, I wrote it up and discussed it with others in the group, like David Crane, Bob Whitehead, and Larry
Kaplan."[cxii]* - Alan Miller

The 2600 as designed was a hacker's machine. It was deceptively simple, but with enough "open" and explorable parts
that more and more power would be squeezed out of it for almost 20 years.

*"Most early VCS ROM carts were only 2Kbytes. Programmers had to put tremendous effort into implementing a decent
game in that small space."* [cxiii] - Alan Miller

To program the VCS developers had to "unlearn" good programming practices to get their code to fit within the bizarre
hardware. Tricks were passed around by programmers, and new programmers would have to pick them up quickly if they
were going to be successful. Joe Decuir developed the color-cycling routine of the VCS to help stop "burn-in" that was a
complaint of the *Pong* systems, which also doubled as a feature in games. "Flicker" (objects flashing on the screen) was
caused by a trick that let programmers get more objects on the screen than were allowed.

Atari showed the VCS at the Summer CES in 1977, and prepared it for release in October. They knew that had the best
product on the market, but they did not know how to inform the public of that fact.

During the manufacturing process, they ran into some problems that delayed the release of the unit. The VCS was very
difficult to produce and test. The design required two types of screws that were difficult for assembly line workers to
distinguish. Also, the cases were created as two plastic parts that would warp if not used quickly after being
manufactured. The multiple integrated circuits and reliance on both cartridges and a television made testing the 2600
units extremely difficult. Some supplier chips were not fast enough for production 2600's, but passed inspection because
they worked fine in individual unit tests -- but not when the machine was put together. All of these things led to shipping
delays and disappointed retailers.

By late November 1977, the Atari VCS shipped to retailers, including
Sears who marketed their own version named the Sears Tele-Games
Video Arcade. The system cost $199 and included the console, TV
switchbox, two joysticks, a set of paddle controllers, and the pack-in
game *Combat*. Eight other games were released with the console, most
of which were conversions of Atari's most popular coin-op games from
years past.

Combat was programmed by Joe Decuir, Larry Wagner. Larry Kaplan.
It was based on the *Tank!* and *Jet fighter* coin-ops. It was the perfect
pack-in game for the VCS. It displayed incredibly addictive two player
action, and contained one of the best two player games ever designed,
Tank Pong.

"The first time I saw Combat *on display in the local Fedmart TV*

section, I was blown away. There were actual arcade games up on that screen." - Anonymous Atari Fan

Air-Sea Battle was programmed by Larry Kaplan. It was based on the *Destroyer* and *Anti-Aircraft* coin-ops.

"Air-Sea Battle *was based on an Atari coin-op called* Anti-Aircraft. *In those days, we just ripped off anything we could make work."[cxiv]* - Larry Kaplan

Besides engrossing two player action, *Air-Sea Battle* was packaged behind some of the best box-art ever created for a video game. The art was painted by Cliff Spohn, who also painted the amazing art for *Combat*, *Street Racer* and several later games.

"Those paintings on the box detailed exactly how I felt about the games. The graphics were so minimal at the time, the boxes formed an important part of game play experience. When I was playing Air-Sea Battle, *I was playing in that painting."* - Anonymous Atari Fan

Video Olympics was programmed by Joe Decuir. It included every imaginable variation of *Pong*. The idea was to make any and all dedicated *Pong* units obsolete with this cartridge. The game allowed 1-4 players, and contained many variations and was based on Atari coin-ops like *Pong, Pong Doubles, Goal IV, Quadrapong* and *Rebound*.

Street Racer was programmed by Larry Kaplan. It contained 27 1-4 player top-down racing games with very basic graphics and sound. Its saving grace was the strangely addictive "Number Cruncher", where players raced to catch the biggest numbers possible.

Surround was programmed by Alan Miller in four months.[cxv] It was based on the *Dominos* coin-op with added variations.

"Surround *was based on a game play concept implemented in several arcade games in the mid-70s, such as Atari's* Dominos, *Gremlin's* Blockade, *and Meadow's* Bigfoot.*"* [cxvi] - Alan Miller

Indy 500 was programmed by Ed Riddle. It was based on the *Gran Trak 10*, *Gran Trak 20*, *Indy 4, Sprint, LeMans,* and *Crash n' Score* coin-ops. *Indy 500* shipped with the "Racing Controllers" included in the box.

"A total of 14 game variations enliven this auto sports cartridge. It is priced somewhat higher than all the other early Atari releases because it includes a pair of specially designed game controllers."[cxvii] - Arnie Katz And Bill Kunkel

Also released were *Star Ship* programmed by Bob Whitehead and based on the *Starship 1* coin-op, *Blackjack* programmed by Bob Whitehead, and *Basic Math* programmed by Gary Palmer.

The late shipments and consumer indifference led to soft sales for Christmas 1977. The VCS was the best selling console that season, but that did not amount to much. By the end of the 1977-1978 fiscal year in June, Atari had sold most of the 400,000 units manufactured, and had sales of $120 million, but still lost money on the VCS.[cxviii]

"People didn't know whether to spend $30 to $50 on the numerous dedicated games that were still on the shelves or slap
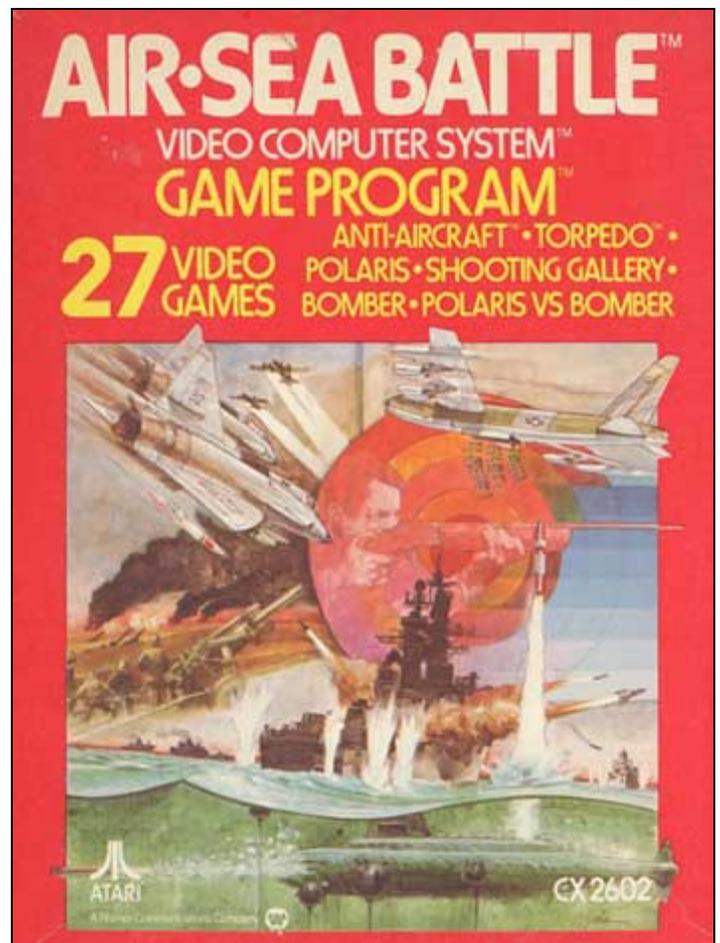
down $180 for the VCS, a considerably larger expense."[cxix] - Alan Miller

The nine original cartridges were thought to stretch the Atari VCS to the limit. Just before its release, Bushnell quickly started to work on a follow-up machine. He, wanted to create a next-generation VCS that fixed all the limitations of the original unit.

"In the Summer of 1977, I went back to Grass Valley to work with Ron and Steve on the next generation machine."[cxx] - Joe Decuir

Nolan Bushnell was convinced that hardware only had a 2-year life-span, and he wanted to make sure Atari was ready with a follow-up to the VCS as soon as possible. However, with sluggish initial sales, the VCS had to prove itself in the marketplace first before any new consoles could be fully developed.

[Look forward to the continuation of The History of Atari on Gamasutra.com.]

Sources

Image attributions: All arcade flyer scans taken from The Arcade Flyer Archive with permission. VCS and Sears catalog images and *Air-Sea Battle* box scans taken from AtariAge with permission.

i Steve Fulton interview with Nolan Bushnell, August 2007

ii Steve Fulton interview with Nolan Bushnell, August 2007

iii Steve Fulton interview with Nolan Bushnell, August 2007

iv Salon.com, The adventures of King Pong By David Pescovitz

v Steve Fulton interview with Nolan Bushnell, August 2007

vi Washington Post, April 28th, 1978

vii The First Quarter by Steven L. Kent

viii Rec Room Amusemements Interview With Nolan Bushnell, http://www.recroom-amusements.com/bushnell.htm

ix Steve Fulton interview with Nolan Bushnell, August 2007

x The First Quarter by Steven L. Kent

xi www.icwhen.com

xii Good Deal Games Nolan Bushnell Interview http://www.gooddealgames.com/interviews/int_bushnell.html

xiii Zap: The Rise And Fall Of Atari By Scott Cohen

xiv Phoenix Page 13 – 14

xv "ATARI, INC. THE EARLY YEARS" by Colin Covert, HI-RES VOL. 1, NO. 1

xvi Good Deal Games Nolan Bushnell Interview http://www.gooddealgames.com/interviews/int_bushnell.html

xvii Steve Fulton interview with Nolan Bushnell, August 2007

xviii http://bb.vg-network.com/ Al Alcorn Interview

xix Zap: The Rise And Fall Of Atari By Scott Cohen

xx Salon.com, The adventures of King Pong By David Pescovitz

xxi http://bb.vg-network.com/ Al Alcorn Interview

xxii http://bb.vg-network.com/ Al Alcorn Interview

xxiii www.icwhen.com

xxiv The REAL "PONG" F.A.Q. by Sly D.C.

xxv http://bb.vg-network.com/ Al Alcorn Interview

xxvi C/Net News.com "The return of King Pong" by David Becker

xxvii High Score by Rusel Demaria and Johhny L. Wilson

xxviii Phoenix Page 15

xxix Flyer used courtesy of Dan Hower, www.arcadeflyers.com

xxx "ATARI, INC. THE EARLY YEARS" by Colin Covert, HI-RES VOL. 1, NO. 1

xxxi www.arcadeflyers.com

xxxii Business Week Nov. 1976

xxxiii Business Week Nov. 1976

xxxiv Nolan Bushnell Interview With Steve Fulton, August 2007

xxxv C/Net News.com "The return of King Pong" by David Becker

xxxvi Nolan Bushnell Interview With Steve Fulton, August 2007

xxxvii The First Quarter by Steven L. Kent

xxxviii C/Net News.com "The return of King Pong" by David Becker

xxxix Zap: The Rise And Fall Of Atari By Scott Cohen

xl Zap: The Rise And Fall Of Atari By Scott Cohen

xli Zap: The Rise And Fall Of Atari By Scott Cohen

xlii Nolan Bushnell Manifesto To Atari employees

xliii Flyer used courtesy of Dan Hower, www.arcadeflyers.com

xliv www.klov.com

xlv Flyer used courtesy of Dan Hower, www.arcadeflyers.com

xlvi The First Quarter – Steven L Kent page 55

xlvii Business Week, November 10, 1973

xlviii Flyer used courtesy of Dan Hower, www.arcadeflyers.com

xlix Flyer used courtesy of Dan Hower, www.arcadeflyers.com

l Newsweek, Dec. 17, 1973

li Business Week, Nov. 10 1973

lii Business Week, Nov. 10 1973

liii Business Week, Nov. 10 1973

liv Flyer used courtesy of Dan Hower, www.arcadeflyers.com

lv Superpong Advertising Flyer

lvi Flyer used courtesy of Dan Hower, www.arcadeflyers.com

lvii www.andys-arcade.net

lviii Flyer used courtesy of Dan Hower, www.arcadeflyers.com

lix http://bb.vg-network.com/interview with Al Alcorn

lx www.icwhen.com

lxi Zap! The Rise and Fall of Atari – Scott Cohen – Page 42

lxii Zap: The Rise And Fall Of Atari By Scott Cohen

lxiii www.atarimuseum.com

lxiv Zap: The Rise And Fall Of Atari By Scott Cohen

lxv C/Net News.com "The return of King Pong" by David Becker

lxvi www.klov.com

lxvii Nolan Bushnell interview with Steve Fulton, August 2007

lxviii "The incredible, incredible story of Atari" By Steve Bloom

lxix GoodDealGames.com Interview with Nolan Bushnell

lxx C/Net News.com "The return of King Pong" by David Becker

lxxi http://bb.vg-network.com/ interview with Al Alcorn

lxxii Steve Wozniak Interview with Benj Edwards http://www.gamasutra.com/features/20070504/edwards_01.shtml

lxxiii Steve Wozniak Interview with Benj Edwards http://www.gamasutra.com/features/20070504/edwards_01.shtml

lxxiv The Complete Story Of Pong by Marty Goldberg http://classicgaming.gamespy.com/View.php?view=Articles.Detail&id=395

lxxv http://marvin3m.com/video/atari.htm

lxxvi The First Quarter by Steven L. Kent

lxxvii Owen R. Rubin Interview by Brian Deuel

lxxviii http://marvin3m.com/video/atari.htm

lxxix http://www.arcade-history.com/index.php?page=detail&id=1770

lxxx http://www.podtech.net/home/?p=881

lxxxi IEEE Spectrum, March 1983, pp. 45-51

lxxxii Joe Decuir Interview, http://www.digitpress.com/library/interviews/interview_joe_decuir.html

lxxxiii http://www.atarimuseum.com/videogames/consoles/2600/proto2600.html

lxxxiv http://www.atarimuseum.com/articles/joedecuir.html

lxxxv Curt Vendel Interview With Joe Decuir , http://www.atarimuseum.com/articles/joedecuir.html

lxxxvi Joe Decuir Interview, http://www.digitpress.com/library/interviews/interview_joe_decuir.html

lxxxvii C/Net News.com "The return of King Pong" by David Becker

lxxxviii Steve Fulton Interview with Nolan Bushnell August 2007

lxxxix Salon.com, The adventures of King Pong By David Pescovitz

xc C/Net News.com "The return of King Pong" by David Becker

xci http://www.atari7800.com/html/documents_articles_10.htm

xcii The incredible, incredible story of Atari — from a $500 lark to a $2 billion business in 10 short years By Steve Bloom

xciii http://www.gamealmighty.com/story-individual/story/Sharing_Space_with_Owen_Rubin/2/

xciv http://www.rawbw.com/~delman/superbug.html

xcv http://www.rawbw.com/~delman/canyonb.html

xcvi http://marvin3m.com/video/atari.htm

xcvii http://www.arcade-history.com/index.php?page=detail&id=2626

xcviii Replay Magazine, October 1975, p. 38

xcix Nolan Bushnell interview with Steve Fulton, August 2007

c Nolan Bushnell interview with Steve Fulton, August 2007

ci Coin Connection March 1977

cii http://www.gamearchive.com/Pinball/Manufacturers/Atari/atarians/atarians.html

ciii Replay Magazine, December 1977, p. 79

civ The First Quarter by Steven L. Kent, page 97

cv The incredible, incredible story of Atari — from a $500 lark to a $2 billion business in 10 short years By Steve Bloom

cvi Coin Connection

cvii http://www.pong-story.com

cviii www.atarimuseum.com

cix http://www.digitpress.com/library/interviews/interview_larry_kaplan.html

cx 3 Generations Of Game Machine Architecture by Joe Decuir: http://www.atariarchives.org/dev/CGEXPO99.html

cxi Design case history: the Atari Video Computer System, IEEE Spectrum, March 1983, pp. 45-51, http://www.atarimuseum.com/videogames/consoles/2600/Atari_case_history.html

cxii http://www.digitpress.com/library/interviews/interview_alan_miller.html

cxiii http://www.digitpress.com/library/interviews/interview_alan_miller.html

cxiv Larry Kaplan Interview With Digital Press (http://www.digitpress.com)

cxv http://www.digiserve.com/eescape/atari/articles/Meet-David-Crane.html

cxvi http://www.digitpress.com/library/interviews/interview_alan_miller.html

cxvii The Player's Strategy Guide To Atari VCS Home video Games

cxviii IEEE Spectrum, March 1983, pp. 45-51

cxix "The incredible, incredible story of Atari — from a $500 lark to a $2 billion business in 10 short years."by Steve Bloom, http://www.landley.net/history/mirror/atari/museum/cut2pin.html

cxx Curt Vendel Interview With Joe Decuir , http://www.atarimuseum.com/articles/joedecuir.html

Return to the full version of this article with comments