

SILICON VALLEY U.S.A.

(This is the first of a three-part series on the history of the semiconductor industry in the Bay Area, a behind-the-scenes report of the men, money, and litigation which spawned 23 companies — from the fledgling rebels of Shockley Transistor to the present day.)

By DON C. HOEFLER

It was not a vintage year for semiconductor start-ups. Yet the 1970 year-end box score on the San Francisco Peninsula and Santa Clara Valley of California found four more new entries in the IC sweeps, one more than in 1969.

The pace has been so frantic that even hardened veterans of the semiconductor wars find it hard to realize that the Bay Area story covers an era of only 15 years. And only 23 years have passed since the invention of the transistor, which made it all possible.

For the story really begins on the day before Christmas Eve, Dec. 23, 1947. That was the day, at Bell Telephone Laboratories in Murray Hill, N.J., three distinguished scientists, Dr. John Bardeen, Dr. Walter Brattain and Dr. William Shockley, demonstrated the first successful transistor. It was made of germanium, a point-contact device that looked something like a crystal detector, complete with cat's whiskers.

The three inventors won the Nobel Prize for their efforts, but only one of them, Dr. Shockley, was determined to capitalize on the transistor commercially. In him lies the genesis of the San Francisco silicon story.

It was only by a quirk of fate, however, coupled with lack of management foresight, that Boston failed to become the major semiconductor center San Francisco is today. When Dr. Shockley left Bell Labs in 1954, he headed first for New England to become a consultant to Raytheon Co., with a view toward establishing a semiconductor firm there under its auspices.

His financial plan called for a guarantee to him of \$1 million over a 3-year period — hardly unreasonable by today's standards. But the Raytheon management 16 years ago couldn't see it, so Dr. Shockley left the company after only 1 month.

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When Raytheon closed the door, it inadvertently set in motion a whole new cycle which was ultimately to result in the complex of nearly 25 chip makers in the San Francisco Bay Area.

Returns Home.

For Dr. Shockley was a native of Palo Alto and a Stanford alumnus, and his next move was to return home. Thus, in 1955, with the backing of Beckman Instruments, in Palo Alto was born Shockley Transistor Corp., the direct antecedent of nearly every semiconductor firm in the Area today.

Despite an uncanny genius for spotting and recruiting talent ("hero worship," admitted one of his early employes), he was less adroit in managing that talent.

Within 2 years there was much internal unrest at Shockley Transistor, much of it centered on Dr. Shockley's decision to concentrate on four-layer diodes rather than the product in the company name. A group of palace revolutionaries even went to Dr. Arnold Beckman, president of the parent company, with a plan which would move Dr. Shockley to emeritus status and relieve him of operating control. Dr. Beckman was agreeable, but Dr. Shockley held veto power, and he exercised it.

The young revolutionaries thereupon gave up on Shockley Transistor, and sought backing for a company of their own. The father of one of them had a contact with the brokerage house of Hayden, Stone, which in turn found a willing backer in Fairchild Camera & Instrument Corp., then of Syosset, N.Y. Thus, in September, 1957, only 2 years after Dr. Shockley came to the Coast, was born the most fecund of all the semiconductor firms, Fairchild Semiconductor.

The Young Turks who founded the company — now all departed — were: Dr. Robert Noyce; Dr. Gordon Moore; Dr. Jean Hoerni;

Dr. Jay Last; Dr. Victor Grinich; Dr. Sheldon Roberts; Julius Blank and Eugene Kleiner. Dr. Shockley called them "the traitorous eight."

Shockley Transistor never recovered from the blow, although the company staggered along, through three owners, until mid-1968. Beckman gave up and sold the company to Clevite, which gave up and sold it to ITT. ITT gave up, couldn't sell it, and shut it down.

Only Facility Remains.

All that remains of Shockley Transistor Corp. Today is an elaborate facility, empty for 2.5 years, at the corner of Page Mill Road and Foothill Expressway in Palo Alto. It still carries the sign, "ITT Semiconductors," but in Stanford Industrial Park, where real estate often commands triple the prices of surrounding property, it is a white elephant no semiconductor firm can afford.

Meanwhile, Fairchild had gone through a trauma of its own. Since all eight of the founders were technologists rather than businessmen, the FC&I management in New York deemed it essential to import a professional manager to run the plant.

That first general manager was Dr. Ewart M. (Ed) Baldwin, who was recruited from Hughes. Although not one of the founders, he was given a founder's share, plus other incentives whereby he might have made more money than any of the founders.

(Ironically, the success story of the Fairchild founders — which has been probably the largest single factor in stimulating spinouts — was not nearly as successful as is generally believed. Dr. Noyce recently remarked that his total capital-gains taken out of Fairchild amounted to \$240,000. Even more ironic, the founders of that spectacular loser, General Micro-Electronics, each walked away with \$300,000.)

But whatever Dr. Baldwin might have taken out of Fairchild, he threw it all over in

March, 1959, when Fairchild was only 1.5 years old. With backing from Rheem Manufacturing, he pulled out to form Rheem Semiconductor, taking 10 key Fairchild people with him.

Dr. Noyce, the 32-year-old scientist with no management experience, reluctantly agreed to take the top job temporarily, and that temporary job lasted 9 years.

The Fairchild management was furious with Dr. Baldwin, and they sued him and Rheem, claiming, among other things, that he had stolen their cook book. Even more mysterious, they claimed, the process manual was later returned in the mail, in plain envelope, without return address.

Cook Book Story 'True.'

Digging into the case recently, this writer asked one of the key Rheem people of that day if the story of the cook book were true. "Sure it was," he said. "But the thing that got us off was the doctrine of clean hands. When we told what they did to Shockley, the court was not so impressed with what Rheem supposedly did to them."

Not that Rheem got off scot-free. The case was settled out of court, and while the parties agreed to keep the terms secret, it can now be revealed that Rheem paid Fairchild \$70,000 and agreed to refrain from using one of Fairchild's proprietary process steps.

Although the settlement was cheap, the suit crippled Rheem in other ways, and after 2.5 years in business, the company caved in and was sold to Raytheon. So in 1961, Raytheon acquired the first spinout from Fairchild, which was the first spinout from Shockley, which they could have had in the first place, 7 years before.

There was bad blood between the companies for years, but time has healed the wounds, and now Fairchild and Raytheon are peaceful next-door neighbors on Ellis Street in Mountain View.

Dr. Baldwin faded from the scene soon thereafter and, when last heard from, he was starting a hybrid IC firm in the Conejo Valley in southern California.

Meanwhile at Fairchild, while things were going swimmingly in the marketplace, relations between Mountain View and Syosset headquarters were becoming increasingly strained. New York tried to impose eastern working conditions on the California plant; the company's stock-option plan for key employes was penurious; and too much of the cream being generated in California was skimmed off to finance ill-advised acquisitions by New York.

The operators of the profit center in Mountain View became convinced they were being bilked. And thereby were sowed the seeds of discontent, which created troubles Fairchild has not yet outlived.

Half Pull Out in 1961.

These conditions led directly to half of the Fairchild founders pulling out in 1961. Dr. Hoerni, Dr. Last, Dr. Roberts and Mr. Kleiner left to form Amelco, a cornerstone in the later huge Teledyne complex. Although Amelco (now Teledyne Semiconductor) has never been a major challenger to Fairchild in the marketplace, the move proved to make sound economic sense for the defectors. This despite the fact that only one of the four, Dr. Last, remained with the firm. Today, up in the corporate headquarters of Teledyne, he is far removed from Amelco.

Dr. Hoerni left Amelco in 1964, along with Robert Freund, another ex-Fairchilder, to set up a semiconductor department for Union Carbide Electronics (UCE). In 1967 he left UCE to found Intersil. Mr. Freund retired shortly thereafter, and UCE Semiconductor was taken over by still another ex-Fairchilder, David Beadling.

Mr. Beadling moved UCE south to San Diego, out of the Bay orbit, and in 1969 the operation was sold to Solitron. About the same time, Mr. Beadling left to help found another company in the San Diego area, Garrett Micro-Circuits, a second source to American Micro-Systems. The parent company is Garrett Corp., and AMI is also heavily involved. Still another San Diego entry upcoming is Burroughs Corp., also setting up with AMI know-how.

That makes three semiconductor firms in the San Diego area, all Fairchild-descended. Even though Fairchild itself has abandoned its plans for a major facility there, San Diego may yet become the next semiconductor center of the world. But that is another story.

Still another UCE-Solitron spinout was James Paris, also ex-Fairchild, who moved east in 1970 to Treose, Pa., to found Unisem with United Aircraft backing.

Birth of Signetics.

Returning to 1961, when Fairchild lost four of its eight founders, another significant spinout that year was Signetics, involving such key people as Dr. David James, David Allison and Orville Baker. Later they brought in F. Joseph Van Poppelen, Jr., from Motorola first to head marketing, and later as general manager. Original financing was by Lehman Bros., but the New York bankers couldn't stand California-style losses, so they sold control to Corning Glass works.

Corning later sent in James F. Riley to head the company, and his arrival was greeted with a notable lack of enthusiasm on the part of Mr. Van Poppelen and the founding troops. A few months later they organized a cabal which was designed to Deep-Six him, but their security was sloppy. They didn't reckon with paper-thin walls, nor the fact that Mr. Riley was in an adjacent room, overhearing the details of his intended demise.

But he survived, and Mr. Van Poppelen departed, with the comment: "Only a few more months — a few lousy months — and we never would have needed that Corning money."

Signetics has been remarkably free of spin-outs, although the firm backed an unusual spinoff in 1969. Orville Baker and David Allison wanted a company of their own, and Mr. Riley was able to convince them that they could do as well remaining under the Corning banner. The result was Signetics Memory Systems, a Signetics Corp. subsidiary with interlocking directors.

There was to have been a third founder, Zeev Drori, then with Fairchild and earlier with IBM. But when he came to the signing to close the deal, he discovered that Corning had inserted a new clause without prior discussion. This had to do with rights to re-acquire founder's stock, and Mr. Drori regarded it as inimical to his interests.

He therefore backed out of the deal at the last minute. Instead he went out and found other backing early in 1970, forming Monolithic Memories with other founders from National and Texas Instruments. Monolithic Memories is confining its efforts to bipolar memories, since one of its backers is Electronic Arrays, an MOS-only house.

While the founding of Signetics Memory Systems kept two of Signetics' most valuable properties in-house, it may have created as many problems for Corning as it solved. The party line is that Signetics is a device company and Signetics Memory is a systems company, and never the twain shall compete. But talk to the marketing troops of the respective companies, and you get quite a different story.

(Next week, the formation of the legendary General Micro-Electronics; the entry of Philco-Ford, the departure of Howard Bobb and the debut of AMI; Peter Sprague finds his man — at Fairchild.)

SILICON VALLEY-U.S.A. PART II

(This is the second of a three-part series on the origin of the semiconductor business in the Bay Area. The first instalment traced the startup of Shockley Transistor, ending with the creation of Signetics.)

By DON C. HOEFLER

Soon after the formation of Signetics in late 1961, James Nall left Fairchild to form Molectro Corp. This was one of the very few Fairchild spinouts which failed, but it did serve later as the partial nucleus of the revitalization of National, to be discussed presently.

The biggest loser ever to spin out from Fairchild was

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begun in 1963, with a retired Marine Colonel named Arthur Lowell, and a Fairchild group including James P. (Phil) Ferguson, Robert Norman and Howard Bobb. The company was General Micro-Electronics, the first specifically formed to exploit the MOS (metal-oxide-silicon) technology.

Colonel Lowell was a high-flying promoter, and when word was circulated that GM-E was backed by General Motors, he just smiled and said nothing. Finally GM took notice of the rumor, and issued a press release denying it.

He was also involved, in August, 1963, in a legendary interview with Alfred D. Cook, then editor of Electronic News. "The colonel said we were going to have 24 plants in 12 months," recalls Howard Bobb. "I wanted to jump in and say, 'No, it's 12 plants in 24 months.' Afterwards I asked him if he was counting outhouses."

GM-E was the seventh spinout from Fairchild (including two equipment companies not shown in the map above). The brass in Syosset were getting uptight about the defections, and ordered Mountain View to sue.

Like the Rheem case, the GM-E suit was settled out of court; and, as in the Rheem case, both parties agreed to keep the terms secret.

It can now be revealed, however, that no money changed hands. "But to get them off our backs, we had to come up with something face-saving," a former GM-E insider recalls. "So we found a process in which we had no

interest, and then promised not to use it."

The founding and failure of GM-E has an interesting parallel movement starting back in New Jersey in the early 1950s. There, young Dr. William Hugle was being forced out of the synthetic gem business by Union Carbide. He was looking for a new venture when he came upon a list of the first 10 licensees of the Bell Labs semiconductor patents through Western Electric.

The list included all of the giants of electronics, such as RCA, GE, Westinghouse, Philco, Sylvania and Raytheon. But down at the bottom were two little-known names, Texas Instruments, and Baldwin Piano. Dr. Hugle wrote the two dark horses, offering his services, and those of his wife, Dr. Frances Hugle.

TI never answered the letter, but Baldwin did. Its interest in transistors was for electronic organs, and possibly military and industrial electronics. The two Drs. Hugle moved to Cincinnati to join Baldwin, forging a friendly relationship which continues to this day.

The Hugles later left Baldwin Piano for Westinghouse, first in Pittsburgh, and later in Newbury Park, Calif. Later they migrated to the Bay Area. In 1962, Dr. William Hugle formed Hugle & Lee, with Dr. Richard E. Lee of Texas Instruments. The partnership operated initially as a consultant firm, but ultimately evolved into Siliconix, with backing from Baldwin, plus Electronic Engineering Co. of California.

Soon there were policy differences, however, and the Hugles pulled out of Siliconix the

following year. Thus it was that in early 1963, both Dr. Hugle and Colonel Lowell were looking for backing for new semiconductor companies.

Dr. Hugle was closing in on Pyle-National in Chicago, and Colonel Lowell was closing in on Stewart-Warner, also in Chicago. The two companies are in fact next-door neighbors, and Dr. Hugle and Colonel Lowell frequently bumped into each other in those days.

Both of the potential sponsors were adamant that the new semiconductor firms were to be set up in Chicago. Dr. Hugle was equally adamant in insisting to Pyle-National that manpower problems would make that impossible. Colonel Lowell was presenting the same argument to Stewart-Warner. As a result, both negotiations broke down.

This had a settling effect on both companies. They reopened negotiations, willing to start up in California. But they apparently used a DPDT switch to turn things on again, and the dancers had changed partners. Thus it happened that Pyle-National wound up backing Colonel Lowell in GM-E, and Stewart-Warner set up Stewart-Warner Microcircuits under Hugle.

At GM-E, Colonel Lowell had ideas so grandiose that they nearly wiped out little Pyle-National. But Philco-Ford came to their rescue in 1966, buying the company and putting the name to rest forever. Thus the company that was once rumored to be a GM model found itself in the Ford garage.

But Philco soon found that trying to tame

GM-E was like trying to grasp an eel in a barrel of water. Like most eastern companies, it thought stock options were kind of funny, while the GM-E troops who found themselves working strictly for salary again, didn't find it funny at all.

Philco's operating losses for the division were exceeding \$1 million a month, and key people were planning mass defection. Philco finally gave up in 1968, closed the operation and headed back home for Pennsylvania.

The first significant spinout from Philco — GM-E was American Micro-Systems, headed by Howard Bobb, in 1966. This group accomplished what GM-E was never able to do — make a profit in MOS. Many others have since tried to emulate AMI's performance, but the company still controls close to 50 per cent of the market.

AMI soon was followed by Dr. James McMullen, Earl Gregory and others, who formed McMullen Associates, which ultimately became Electronic Arrays. This group thought they were set with Sangamo Electric, but Sangamo also balked at McMullen's key-employee stock option plan.

Sangamo was quite willing to provide a nice ownership package for the founders, but could not be convinced that additional options would be required for recruiting. It finally backed off, and the McMullen group had to start over again looking for money. They found it, mostly among some wealthy individuals in Beverly Hills, plus a nice infusion from the Dutch Philips Company, and Electronic Arrays finally opened its doors in 1967.

The year 1967 also saw the reorganization of National Semiconductor Corp. as it exists today.

The company had been formed in Danbury, Conn., in 1959, when Dr. Bernard Rothlein led a group out of Sperry Semiconductor. Sperry didn't take too kindly to that, and sued. This action, however, made Fairchild's suit against Rheem in the same year look like a church social. Sperry was going for the jugular, and found it.

Sperry's Exhibit A in the court room was a large blow-up of its organization chart before Dr. Rothlein and his group left. Then the Sperry barrister slowly and dramatically placed large black squares, one by one, over each box which represented a defector. It was a hokey performance which probably would be laughed out of court in high-turnover California, but it did the job and brought National to its knees.

By 1967, National was nearly out of business in Danbury, and the same was true of Molectro in Santa Clara. Then along came a new group of investors, headed by Peter Sprague, who put it all together. They acquired the National and Molectro shells, dropped the Molectro name, and moved the National headquarters to Santa Clara. They also made a few management changes.

Charles E. Sporck, general manager at Fairchild, became president of National, bringing with him a group which included Fred Bialek, Pierre Lamond, Roger Smullen and, later, Don Valentine. Coming from the back of

the pack, this group in 3 years brought National to a neck-and-neck fight with Signetics for fourth place.

It may be wondered why, since this was potentially the most damaging spinout yet, Fairchild didn't sue National, as it had Rheem and GM-E. One obvious reason is Mr. Sporck's strong friendship with the Fairchild top line, plus the many real contributions he had made to that company.

But another reason may be that a number of Fairchild's insiders made substantial capital gains in National stock, buying it at very depressed prices before the Sporck move was made public.

Spinouts from GM-E continued on into the following year, with the formation of Nortec Electronics by Robert Norman. This was originally a small custom house, funded with his own money and that of other individuals. The firm has been bootstrapped wisely, and Mr. Norman will be in an excellent position to take it public, which he plans to do.

Another GM-E spinout that year was Integrated Systems Technology, a service company headed by Don Farina and recently acquired by Varadyne.

Also formed in 1968 was Qualidyne, originally headed by David Hilbiber, from Fairchild by way of Hewlett-Packard Associates. He subsequently resigned, and the president now is Ward Gebhardt, also from Fairchild, by way of Intersil.

(Next Week: The shot heard 'round the world — Noyce resigns and Sherman Fairchild begins a search that ends in Phoenix.)

(This is the last of three articles on the history of the Bay Area semiconductor industry. The previous article related the startup of General Microelectronics and the rejuvenation of National Semiconductor with Fairchild plasma.)

By DON C. HOEFLER

In July, 1968, it came — the shot heard 'round the world.' Dr. Noyce was leaving Fairchild, and so were Drs. Gordon Moore and Andrew Grove.

The story being told was that Dr. Moore, Fairchild's R & D director, had determined to start a company, and later persuaded Dr. Noyce to accept the presidency. Although Dr. Moore had never been known as a promoter,

the story was just implausible enough to be believable. This writer bought it after having been told by both Drs. Noyce and Moore that it was so.

Dr. Noyce recently admitted, however, that the story was merely a cover to avoid legal entanglements with Fairchild, and that he himself was indeed the prime mover behind Intel Corp.

That move set up a series of chain reactions which has not fully subsided yet. Sherman Fairchild came to realize that Mountain View had to become the headquarters of FC & I, not the satellite tail that wagged the dog. So he set out to find, not a group vice-president, but a new president.

After weeks of searching, and some near-misses, Mr. Fairchild found his man: Dr. C. Lester Hogan, head of Fairchild's arch-enemy, Motorola Semiconductor.

In January-February of that year, Dr. Hogan had been in negotiation with General Instrument, for himself and a group of Motorola executives — later to be known as 'Hogan's Heroes' — to join that company. It has since been speculated that in making the Fairchild deal, Dr. Hogan has at least as much concern with his moral obligation to the 'heroes' as to the needs of Fairchild. He brought the group with him to Fairchild, but a year later publicly admitted it had been a mistake.

The choice was traumatic for many Fairchild veterans, and the pace of spinouts increased at once. The first came out of Fairchild R & D. Precision Monolithics was formed by Marvin Rudin and Dr. Garth Wilson, with 40 per cent of the backing from Bourns, Inc., which has an option to acquire control in 1974.

Another 1968 spinout was Computer Microtechnology, with a founding group all ex-Fairchild except the president, Francis Megan. He hails from ITT Semiconductors' facility in West Palm Beach, Fla.

Having a more variegated lineage is Advanced Memory Systems, with president Robert Lloyd out of IBM, and other founders from Motorola, Collins and Fairchild.

In late 1968, Dr. Hogan removed Jerry Sanders from marketing responsibility at Fairchild, and offered him instead a contrived vice-presidency with a vague charter. Mr. Sanders decided to think that one over on the sands of Malibu, when Jack Gifford of Fairchild called him to suggest he join still another group of ex-Fairchilders who were planning to start a company.

That group became Advanced Micro Devices early in 1969, with eight founders from

Fairchild. Thus Fairchild, which was founded by eight people from Shockley, gave up eight people for the founding of AMD.

The last Fairchild spinout of 1969 was Communication Transistor Corp. Although the president, Thomas Ciochetti, came from National, he had previously been at Fairchild and ITT, and all of the other founders are from Fairchild. CTC, an affiliate of Varian-Eimac, specializes in high-frequency devices.

The Riley Bombshell.

The Noyce-Hogan moves of July-August, 1968, also set in motion a series of events which culminated in another major upheaval, in August, 1970.

Shortly after Dr. Hogan arrived at Fairchild, a group of marketing people from there headed by Marshall Cox, and a group of engineering people headed by Joseph Rizzi, moved next door to Raytheon. Immediately, Raytheon's prospects zoomed as never before.

The relationship didn't take, however, largely because it was based on salaries rather than capital gains. So early in 1970, both the Cox and Rizzi groups, along with Roger Smullen and Kenneth Moyle of National, joined Dr. Hoerni at Intersil, forming a second company, Intersil Memory Corp. Suddenly Intersil looked like it would be the happening that Raytheon almost was.

But Dr. Hoerni didn't stop there. Since the first of the year he and Fred Adler, New York financier, had been trying to entice James Riley away from Signetics. Mr. Riley had been having the same sort of troubles with Corning that the Fairchild management had earlier encountered with Syosset. Mr. Riley's departure became widely rumored in the industry, but before matters got out of hand, he and Corning closed ranks to deny them, and all seemed quiet again.

Dr. Hoerni never gave up his recruiting, however, nor was he particularly inconspicuous about it.

All summer long, Dr. Hoerni and Mr. Cox continued to work on Mr. Riley. Mr. Cox with the hard sell, and Mr. Hoerni with the soft sell. Then for a change of pace, Mr. Adler would come in from New York with more blandishments.

Finally on Sunday evening, Aug. 30, the officers and directors of Signetics were summoned hurriedly to a secret meeting, where they were told that Mr. Riley's resignation would be announced the following day, and that Charles C. Harwood would be his successor.

Mr. Riley was to become president of Intersil, Inc., a position that Dr. Hoerni conveniently had left open since February.

Two more spinouts appeared on the scene at 1970's year-end. Richard Bader and Thomas Darby, both ex-Fairchild, formed Integrated Electronics with backing from Western Microwave Laboratories and Instrument Systems Corp.

(Ironically, Dr. Moore had insisted on the founding of Intel that a name be chosen which conveyed the idea "Integrated Electronics.")

Philip Shiotani, formerly of Nortec, started advanced LSI technology, with debt financing provided by the Bank of Tokyo.

The latest additions bring to 23 the number of monolithic semiconductor firms in the San Francisco Bay Area. All, except for the two Hugel companies — Siliconix and Stewart-Warner — have blood lines going back to Fairchild, and hence to Shockley.

This common ancestry makes the semiconductor community there a tightly-knit group. Wherever they go, ex-Fairchilders retain an awesome respect and emotional attachment to their Alma Mater. The wives all know each other and remain on the friendliest terms.

The men eat at the same restaurants; drink at the same bars, and go to the same parties. Despite their fierce competition during business hours, away from the office they remain the greatest friends.

And on a rare occasion, when one bends an elbow and lifts a glass, he remembers that it all began with Shockley — only 15 short years ago.

SILICON TREE

