Jerry Gladstone Interview

December 3, 2024 (Interviewers: Estreich, Peterson & Kerwin)

Jerry Gladstone joined Hewlett-Packard in Palo Alto in July 1972. He reported to Pat Wang in the Technology Center within the Microwave Division, with George Bodway the Manager of the Technology Center and Sanehiko "Sandy" Kakihana its R&D Manager. The Technology Center was devoted to making technologically advanced devices and parts for high-performance RF and microwave microcircuits for its test instrumentation products, thereby giving Hewlett-Packard a performance advantage over competitor's instrumentation.

Initially Jerry was assigned to the HP-55 discrete bipolar transistor used in an amplifier for the CATV market. The performance was outstanding; however, HP could not manufacture the CATV amplifier for a price acceptable to the CATV industry. It would not be possible to make a profit on this amplifier, thus Dave Packard declared that HP was not in the CATV components business. At this point Jerry shifted his focus to other bipolar transistors such as the HP-121 and the HP-122. These were bipolar transistors targeted for high gain with low noise. In particular, these low noise transistors was essential for low phase noise performance in the oscillators essential for HP instruments.

These Tech Center silicon bipolar transistors did not use ion implantation or epitaxial layer growth for lower collector resistance or higher breakdown voltage. Small, externally purchased silicon wafers were used with diffusion furnaces to form the base and emitter regions. One the Jerry's many technical contributions was the use of a thin molybdenum layer diffused into the silicon wafer before the standard processing steps in forming the bipolar transistors. The advantage of using the molybdenum diffusion was a reduction in the damage to the silicon devices during their regular processing steps and that lead to improved noise performance. This was important confidential information that gave HP an advantage over others making microwave bipolar transistors. Lower phase noise in

the oscillators using the Tech Center transistors was a major advantage in HP instruments.

While still located in Palo Alto, Jerry was promoted to project manager and then to section manager. When the Microwave Division was chosen to move to Santa Rosa, CA, Jerry was asked to work on the transfer of the fabrication facilities (design and facility planning) to Santa Rosa's Building 1 (to be located on the lower level designated 1LS). The construction of Buildings 1 and 2 at the 1400 Fountaingrove Parkway site occurred in the 1974/1975 period. Initially, Daryl Cernusak had brought up a temporary fabrication facility located at the valley site Building 1T on Piner Road which was able to produce HP-21 and HP-12 silicon transistor wafers. Its primary objective was to demonstrate the successful transfer of the processes in operation at the Page Mill Road fabrication facility. The transfer was successful over approximately an eighteen month period and led to the next step being the transfer of the Palo Alto fabrication facilities to the Fountain Grove Parkway site.

Starting in 1975 Jerry collaborated with Tom Wirrick on the Technology Center's transfer to Santa Rosa. When they started the building was completely empty and unoccupied (Jerry mentioned that only the phone lines had been installed when they started work). They had to work within the constraints of the building design given that its architecture was established without any input from Tech Center about their particular needs and requirements. Jerry managed the design of the fabrication facilities by mapping out the process and equipment flows and did all design work requiring detailed knowledge of the fabrication processes and unique equipment requirements. Tom managed every aspect of the facility infrastructure matched to the fabrication flows and equipment needs. This was especially demanding given that much of Tech Center's equipment was not standard due to numerous modifications made by the Tech Center engineers.

Many stories could be told about these special needs due to modified processes used by the Tech Center. For example, in the early days wafers fabricated by the Tech Center were smaller than what the semiconductor

industry was routinely using and this meant that often the processing equipment had to be modified to accommodate the smaller wafers (and also unique processing). As an example, early lithography used the Kasper proximity aligner with 10:1 projection printing. Incidentally, 10X masks were created from hand-cut Rubylith® red masking layers to do this. The use of monochromatic light in the aligner created undesired standing waves. To solve this problem the use of an anti-reflection coating had to be developed.

Jerry was very involved with the technology roadmap followed over the years by the Tech Center. Some examples include (1) ion implantation for doping and isolation, (2) epitaxial growth of doped layers on wafers, (3) plasma processes for deposition and etching, and (4) electron beam (E-beam) for lithography. The E-beam project was a huge project that Jerry championed. It was initially started at Hewlett-Packard Laboratories (HPL) and then it was decided that Jerry should continue the project at Santa Rosa. The objective was to allow for very fine line lithography as required for microwave and mm-wave devices such as field-effect transistors. This was a very significant technical contribution made by Jerry.

One topic that emerged during the interview was the hiring of Dick Puttbach to come in and bring up YIG crystal growth for use in oscillators and to also growth gallium arsenide crystals. The wide use of both YIG and gallium arsenide by the Tech Center made this attractive because it would allow control over the quality of the material and provide a controlled known supply. Both processes involve toxic chemicals, and the crystal growing was relegated to the basement of Build 1 in Santa Rosa. The project also involved the shaping of YIF spheres.

Jerry made major contributions to almost all aspects of the technologies within the Technology Center during his tenure with the Technology Center. In the late 1970's Tech Center began a project to introduce gallium arsenide integrated circuits (GaAs IC). Initially Pat Wang owned this project and asked Rory Van Tuyl to be the project manager of it. For more information, see Rory Van Tuyl's website at https://roryvantuyl.com and in particular see "The Early Days of GaAs ICs"

under Technical Papers. Jerry later managed the GaAs IC program where it grew to be a major contributor to the success of microwave instruments for Hewlett-Package, Agilent Technologies and now Keysight Technologies. Today all major microwave instruments offered by Keysight Technologies contains integrated circuits that have evolved from this program.

Appendix

Construction of HP building 1 in early 1975

(Courtesy of the Santa Rosa Library archives).