yields got bad. I started off making a 1K memory part in gallium arsenide. It worked and the yields were about half of the logic yields. We get a logic yield of 50 or 55 percent on the wafer. There are 208 die sites on a 3 inch wafer so we get just a shade over 100 good die which I think is very good considering the state of the art. When you do that with a 1K memory part, you get about a 25 percent yield, so extrapolating from that to bigger numbers says it's probably not worth the big effort. It seems like there's quite a ways to go--maybe two orders of magnitude--and I'm not quite sure why that is. I may be missing something, but for all the effort that has gone into memory parts in gallium arsenide, and there has been a lot because it's a product the vendor can make not knowing much about computers, they haven't been that successful. What we have are 4K parts which run very hot. They're mostly Japanese experimental parts. We have one or two 16K parts that were culled from a huge number, so it just doesn't seem imminent, nor does it seem all that important.

The silicon memory parts have made dramatic progress. What we have in the CRAY-3 program is a static part with a 22 nanosecond access time, and that fits reasonably well with the gallium arsenide circuits. In the CRAY-2 and CRAY-3 programs, the emphasis is on very large memories. Therefore, you have a large portion of time spent getting to and from the memory. You have to fan out signals over huge numbers and fan them back in again. Then we have to do error correction and other things. When you add up those numbers in the CRAY-3, it turns out that half the time is spent in the gallium arsenide circuits getting to and from the memory, and half is in the die. That's not a bad ratio. It says that you wouldn't want to spend a lot more money for the die in order to get a modest improvement in memory access. So, strange as it seems, that's not a bad mix. There was another interesting coincidence in the circuits that we developed for gallium arsenide with blank paper. There were no rules--pick your own voltages. I picked some voltages which seemed right for gallium arsenide. They were 3.3 volts for a positive voltage and 2 volts for a negative voltage. The signal excursions were from .2 volts to 2.4 volts. This just seemed to happen. What are the voltages that people use in the memory area for TTL interfaces? They're .4 volts and 2.4 volts--they're exactly the same. There's a perfect electrical match right now between the gallium arsenide electrical signals