Introduction by Al Hoagland

I have the great privilege of introducing Al Shugart as our luncheon speaker. I had the opportunity to work for him for a brief period in the early days of the disk drive. You have a copy of his biography, which is included in the Conference presentation material we provided. Al is so well known that he truly falls in that category of individuals that really need no introduction. So I am not going to restate that background information. In reading the material he submitted there were two items in particular that really caught my attention.

One had to do with the statement that he was the program manager of the IBM 2321 data cell program. Given his many major accomplishments I am not sure why this was included, given that the product had both a limited success and a limited life. I showed a picture of this device in my talk. If you also have a question I refer you to Al who may provide an answer in his talk. The second item I will mention is one I would like to elaborate upon. In his biography it states Al Shugart "is renowned for his unconventional thinking and straight forward manner". The wording indicates some public relations editing of a very significant statement providing a perspective on Al. I will elaborate by recounting my personal experiences relating to these characteristics.

The first goes back to early 1960, when the ADF program was going down in flames. Al had just been selected to head the program and turn it around. John Haanstra, whom I earlier mentioned in my talk as a key leader on the RAMAC, previously had been given a major promotion and now was located on the East Coast overseeing for Corporate Headquarters many projects, including the ADF. His task was to get this critical program back on schedule. He came to San Jose to secure an acceptable new plan. A meeting with him involving Shugart, Harker and myself, among others was set up for this purpose. At this time Shugart had essentially no experience in disk drive technology. The goal was to get a schedule commitment from Al. Hours of diskussion passed and Al Shugart continued to maintain "no I can't do that until we understand our technical problems". Haanstra stated he needed a committed schedule to take back to Headquarters. Al refused to change his position and more hours went by. We finally ended up at the same place we started. In the previous months prior to this time the project had gone through managers that bought into the existing schedule in spite of the exposure of the project to several new technologies that were poorly understood. The leadership qualities Al Shugart demonstrated in these discussions made a huge difference to the direction of the program as well as in enhancing the future role of the San Jose laboratory in IBM. I also came away with increased respect for John Haanstra, who turned out to be the messenger of unwanted news, but recognized he had finally had found the right guy to run the ADF program. The behavior of Al was very unusual at a time when Watson Jr. and top management definitely expected the "right" answers.

Second, much later when I started the Institute for Information Storage Technology (IIST), I quickly learned when you solicit corporate funding the first question asked is "who else has signed up? If you have to reply "no one yet" the invariable answer is "I will refer it to my staff or a committee and get back with you". Quickly you learn you need some company that will step out front. Knowing the personality of Al Shugart, I concluded my best hope was to make my case to Seagate. At least I knew I would get a quick yes or no answer. I went to Scott's Valley to meet with Al. I did not have any presentation prepared. I described what I wanted to setup at Santa Clara University and believed I needed corporate sponsors that would make a five-year commitment of funding support. Al listened, stated it sounded like a good idea to him and signed Seagate up right then. His quick support, of course, then allowed me to leverage this commitment with other companies and the rest is history. Along with Rey Johnson, Al Shugart is a historic figure in the creation of the disk drive industry. Certainly Al, himself, has been the major leader guiding and building this key technology sector over the last forty years.

Again, it is a real privilege and pleasure to introduce Al Shugart and I now will turn the podium over to him.

Welcome Al!

Al Shugart

Thank you Al, for that kind introduction. We have Al Hoagland to thank for inviting me to speak today. He's ruined another wise a perfect day today for all of us.

By the way, I included the data cell drive in my biography because, just before I was assigned as program manager, it had been also been screwed up. An IBM Research division review had raised all sorts of red flags regarding whether it would work. What really drove me was to prove the product could work– and it turned out to be a major technical achievement.

I'm actually somewhat embarrassed with people thinking that I knew a lot about magnetic recording. I actually know very little about the subject; but I know a lot of people who know a lot about it. And I think that may be the secret of success. I've received credit for a lot of things in the evolution of disk drives, and don't deserve any of it. For those who really deserve the credit, I sincerely apologize.

I came into the computer industry quite by accident. I graduated from the University or Redlands in 1951 after 4 years and 4 different majors, and took a job with IBM in Santa Monica, California as a customer engineer. (that's field engineer now-a-days) because I could start the day after graduation. I was 20 years old, married with 1 kid, and dead broke.

I learned after one week at IBM that field engineers were the lowest on the totem pole, when a field engineer in the office was promoted to salesman. I'll never forget that early lesson, and I've held it against salesmen ever since.

After having fixed all the troubles one could have with punch card accounting machines, in 1955, about when Scott McNealy was born, I transferred to a small IBM R&D lab in downtown San Jose.

One of my earlier recollections of the IBM lab at 99 Notre Dame Street was watching Don Johnson, one of the pioneers in disk development, pouring iron oxide paint onto a rotating 24 inch disk from a Dixie cup. No clean room, and equipment so crude that the Dixie cup didn't look out of place at all, and I certainly had no idea I was walking into the beginning of a technology and product development program that would have such a profound impact upon the computer industry.

Don was also one of the early disk drive entrepreneurs, having been the founder of IOMEC, in 1968 I believe. Iomec didn't make it, and I don't know where Don is now.

Well, this pouring of iron paint on a 24 inch disk was going on at the small IBM research and development lab in San Jose, about 50 people strong, and the project was a source recording project directed towards solving all the problems of manual tab card tub files. We were going to store data on these disks and it was difficult to accept that we would actually be able to magnetically record 2000 bits per square inch. That was a100 bits per inch at 20 track per inch. Oh, and by the way, of these 50 people at the research and development lab I think only about 15 or so were working on this magnetic disk project, which included an entire system, including the computer. Now-a-days small disk drive startups have more people. Anyway, the plan was that 50 of these 24-inch disks were to be stacked on a vertical shaft, providing a disk drive with 5 million characters of random access storage and weighing about a ton.

We discarded the original approach of horizontal shaft, which was the first model, and the reason was that we saw a potential need for multiple access stations around the perimeter of the disk drive and it made it a little difficult if the shaft were horizontal; maximum access time was about 1½ seconds; average access time was

about 600 milliseconds, and the rotation speed was a very fast 1200 RPM. It was a fixed record machine, with five 100-character records per track. (I keep referring to characters since this was prior to the 8-bit byte; a character consisted of 6 data bits and one parity bit so that each character always had an odd number of bits). No fire code, no ECC, no address marks, no flags for spare tracks. It should have made the controller really easy, but it didn't. We didn't even know how to clock data without a clock track. "Clock track"—probably few people here even know what a clock track is. And by the way, the electronics were all in vacuum tubes. There was no library of semiconductors to chose from, so every time you needed another circuit you had to design it from scratch.

Magnetic head technology was equally crude. The air bearing that separates the head from the disk was created by externally supplied air routed though tiny orifices in the head carrier, which was loaded by air pressure from the same air supply. The external air supply requirements were so extreme that it was impractical to provide for more than two heads for the entire 100 disk surfaces. Therefore, when accessing from one disk to another, the two heads were unloaded, removed horizontally from the stack of disks, moved vertically to the desired disk, then horizontally to the desired track, then loaded again. If that all sounds complicated let me tell you it was. But the thing actually worked and worked pretty well for that day and age. The disk drive rented for about $750 per month, not including the air compressor, which was housed in a separate cabinet and rented for another $150 per month. Those are 1950's kind of dollars. I believe IBM built nearly 5000 of these disk drives, most of them being used in a system called RAMAC--Random Access Method of Accounting and Control. We wanted to call the thing RAM, but a fellow named Potter from Potter Instrument Company had already used that name in a product. There may be people here who remember Mr. Potter and the Potter RAM. But probably none here has heard of Bill Goddard. Bill was awarded the fundamental RAMAC patent, assigned to IBM, and received a belated cash award for his efforts. I guess that makes Bill Goddard sort of the grandfather of the industry.

This demonstration of practical random access storage was the first of what I consider to be five major events in disk drive evolution.

During the early production years of the RAMAC drive, about the time that the president of a small computer company in Maynard, Massachusetts, was being selected as young engineer of the year, (that was Ken Olsen, president of DEC, in case you didn't guess) the very old principle of a gas lubricated bearing was being better understood in the IBM research center in San Jose. A set of technical articles describing the use of this bearing in magnetic recording appeared in the IBM Journal of Research and Development in 1958, and these articles became the bible of a new segment of the computer industry--disk drives. This self-acting, or slider bearing, eliminated the need for an external air supply, and now permitted a magnetic head to be put on each disk surface of the drive. This was the second major event in the disk drive evolution, and, of all the achievements over the years, this was probably the most significant.

While there were several senior scientists contributing to these articles which became the bible for the industry, there were four young engineers who really did the brunt of he experimental work and deserved most of the credit: Jack Harker, Al Osterlund, Russ Brunner and Ken Haughton. Jack Harker served a tour of duty as the IBM in San Jose lab manger and now I believe is retired. I don't know were Al Osterlund is. Russ Brunner became a member of the "dirty dozen" who founded Information Storage Systems, one of the first disk drive startups spawned from IBM. And Ken Haughton became Dean of Engineering at Santa Clara University, and is now consulting and serving on several corporate boards.

And with this big break through in disk drive technology, IBM introduced another 24 inch drive called the 1301, which was physically about the same size as the RAMAC drive, but stored 50 million bytes of data instead of 5. Without the need to move the magnetic heads from one disk to another, the average access time was reduced to just under 200 milliseconds. The recording density increased to 535 bits per inch at a track density of 50 tracks per inch, or 26,500 bits per square inch, an order of magnitude better that the original RAMAC drive.

At this point in time, with the help of the previously mentioned air bearing bible published by IBM, disk drive competitors began to appear; Telex and Bryant are the first two I can recall. I visited both these companies and remember that I was impressed that they had gone as far as they had because it was not an easy project. I believe the Telex Disk Activity was eventually sold to Data Products and I don't know what happened after that. Bryant was a division Excello Corporation which made machines that formed cardboard milk cartons. I don't recall whatever happened to the Bryant Disk Drive Division.

The Telex drive used 24" disks on a vertical shaft, and individual solenoids for accessing each head pair. The Bryant drive had big disks, 36" I think and very thick. Disks were mounted on a horizontal shaft and the entire bank of heads was positioned with a hydraulic actuator. (Cadillac gauge division of Excello) I also recall that while IBM was betting their marbles on disk drives, that UNIVAC made the conscious decision to pursue their fastrand series of magnetic drums instead of disk storage. I'm glad I didn't make that UNIVAC decision. But what the heck, UNIVAC never believed in the 80 column card either, or perhaps you don't remember the UNIVAC 90 column card with round holes—or for that matter perhaps you don't even remember the IBM 80 column standard card either.

But the first disk drive with a head on each surface didn't come easy. We stumbled several times along the way, including making the recording disks out of thin sheet steel instead of aluminum, oxidizing the surface to obtain magnetic properties, and then sandwiching the two thin platters around aluminum honeycomb to get the structural rigidity and flatness. And they worked fairly well, but there were thousands of flaws. We could never get the surface good enough for practical use. We built some probe heads and tried to do vertical recording on there steel disks; and we discovered a glue with temperature characters perfect for matching the magnetic element to the element carrying shoe. The probe heads didn't work and the perfect glue turned out to be water soluble at 150 degrees or so.

We had lots of interesting projects in those early days of magnetic recording. Two of them come to mind, both of those projects run by Ray Herrera. One of the projects was called project *rusty nail,* because one day I asked Ray what was the cheapest way of making a magnetic head and he said wrapping a piece of wire around a rusty nail, and I said lets try it and we did. I don't recall the outcome of that project. We had another project that we called project *beer can* and the concept was to get a very, very inexpensive small magnetic drum. We noticed in the beer industry they were just starting to extrude aluminum beer cans and the surface looked really, really good, so we ordered several cases of beer cans and coated some and tried to record on them. I don't recall the conclusion of the project either. Biggest problem was getting an IBM purchasing to order the beer cans.

Anyway, this was in the early 1960's when IBM's first disk drive with slider bearing heads was in initial production. At that point in time the third major disk drive event happened, and this was the removable disk pack. The removable disk pack was born, and the disk size was now 14 inches instead of 24. Starting first with the 1311 with about 3½ million bytes, the 2311 with 7½ million bytes per pack became an industry standard, and 14 inch disks were here to stay, at least for a long time. The 2311 was quickly followed by the 2314 with a storage capacity of 29 million bytes per pack. The recording density of the 2314 was 220,000 bits per square inch, an improvement of nearly two orders of magnitude over the early RAMAC drive. The guys who deserve the credit for this third big breakthrough were Jack Harker (I talked about him earlier as an author of the bible) and Ken Folger, a market planner who had the foresight and conviction to carry a new concept to success. I think both of these people were handsomely rewarded for their efforts on the first disk pack drive, and deserve all the credit they can get. The 2311 and 2314 markets dramatically exceeded everyone's predictions, and caused the beginning of disk drive plug-compatible companies. The early ones that come to mind are Memorex, Century, Marshall, ISS, Caelus and there were a few others.

The basic technology begun with the 24 inch disk on the 1301continued through the 3330, and a recording density of about 1 ½ million bits per square inch was achieved. At that point the technology was running out of gas, and the 4th major even occurred; introductions of the low mass/low load head. This recording system

became know by all as Winchester Technology, and resulted in a recording density increase to an incredible 7.8 million bits per square inch, as seen in the IBM 3370. Compare this with the 2000 bits per square inch of the original RAMAC drive; recording density had increased by a factor of 50,000 times! Truly 35 years of progress. Ken Haughton was the Winchester program manager, also one of the authors of the Bible, but Don Johnson, the Disk Painter, did the fundamental media interface work several years earlier. They both deserve a lot of credit. But it really all started with a fella named Armand Miller. He had a little head per track disk drive company in the very early days, called DataDisc, who I think really did the first low-mass, lighly-loaded head work. IBM bought a license for his technology. DataDisc went through a name change, and then was bought by Datapoint. I don't know where Armand Miller is, and Datapoint isn't in the disk drive business, any longer. And I'm not sure that Datapoint is even around any longer.

However, if this were the whole history of disk drives, I probably wouldn't be here today. The missing piece is the floppy disk drive; the fifth major event.

The floppy disk was actually a result of advances in semiconductor technology. This may sound strange to you, so let me explain. In the early 1960's with introduction of the IBM system 360, microcode in control memory was employed to a large extent in both CPU's and in peripheral controllers. This control storage was implemented in capacitor and transformer read only memory since magnetic core and semiconductor memories were much too expensive. When the IBM system 370 was introduced with the same basic architecture as the system 360, semiconductor technology had advanced to a point that control storage could now be implemented with semiconductors, and a machine writeable control memory solved a lot of engineering change logistic problems that we discovered with control memory implementation in the system 360. However, since this semiconductor memory was volatile, a control memory load device was required. And although magnetic tape could certainly do the job, the capability of random access storage prompted the development of the floppy disk, an economical program load device that not only loaded the control program, but also diagnostics as required. And control programs were easy to change just by slipping in a new floppy disk. It was but a short step for the desirability of logging on the same device to result in the addition of a write capability. Lo and behold, a small, inexpensive random access storage device that would provide for an absolute market explosion for small systems. (As well as the demise of the punch card for data entry) and I know you all are aware of this explosion.

There are probably 17 guys who take the credit for the floppy, but only three come to mind. The first is Dave Noble, who was the floppy disk program manager at IBM and is the real father of floppy disks in my judgment. The other two men I recall as being instrumental in floppies were Herb Thompson and Ralph Flores who discovered the cleaning jacket that housed the media. The diskette never worked well enough without the jacket, and I don't think the floppy would be here today without that invention. Herb was one of the founders of Shugart Associates and then founded Drivetek.

And I think everything else we've done since then has just been the result of technical evolution and market opportunity.

But the floppy disk wasn't the only key element in the small computer explosion. It took Altair computer and the CPM operating system from digital research to show everyone the true potential. Everybody remembers Steve Jobs and Apple; very few remember Gary Kildall and Digital Research.

I was lucky to have played a role in the early days of floppy's at Shugart Associates, and then a much more long-lived role at Seagate starting several years later.

The beginning of Seagate is sort of interesting, so I'd like to tell you about it.

In late September, 1979, the desktop computer market was going bananas. Millions of units were being shipped annually and most of them had a small auxiliary memory device called a minifloppy disk drive. These

minifloppies were a reduced size version of the original floppy disk drive introduced in volume about five years earlier by Shugart Associates.

I had been working around computers and disk drive memories for over 25 years, and had discovered one fundamental that transcends computer systems of all size; and that is: a computer system's appetite for memory is insatiable.

And that was and is true for even very small computers. As more and more applications were put on these systems, the memory requirements grew. And, in late 1979, these additional memory requirements were being met by adding a second and third and fourth minifloppy disk drive.

Finis Conner, one of the founders with me at Shugart Associates, came to me in late September of 1979 with the idea to build a fixed, rigid disk drive the same physical size as the minifloppy, with higher performance and higher reliability, and with 15 times the storage capacity at 3 times the cost. He said that if this were possible, he could sell to every desktop computer manufacturer that was shipping systems with more than one minifloppy; that is, our device would fill the memory need for more than one minifloppy.

I thought this was possible so we decided to go into business. On October 1, 1979 Finis and I hacked out an 8 page business plan that predicted our nearly taking over the world, and very quickly—it was a very, very aggressive plan. It had to be. Finis and I had both run out of money and our personal habits needed recapitalizing.

Now all we needed was some key people, money, a disk, and a facilty.

Each of us kicked in $10,000 and hit the road with our plan. We found a mechanical engineer, an electrical engineer, and an operations manager very quickly. It seems get-rich-quick schemes are easy to sell to poor people. We decided to let my daughter keep the books until we could afford a financial officer, since she was going to college and worked cheap.

Finding the money to finance the venture wasn't quite that easy. We reasoned that our idea was worth $2 million dollars, and that we would sell 25% of our plan for 500,000.

Our first stop was the Page Mill group. A venture capital group made up of very successful people from the electronics industry. They would be sure to see the wisdom in what we were doing. Bob Noyce, Lester Hogan, John Young, Ken Oshman, and several other equally famous and successful people.

After my presentation, John Young, who, if you don't remember was the president of Hewlett-Packard, said: "Al, why should we pay half a million dollars for only 25% of a company that's only an idea in the minds of you and Finis?"

I said, "John, perhaps you shouldn't." and they didn't. (Finis said I needed to brush up on my marketing technique). But Finis and I decided that perhaps they didn't have enough money. So we set our sights on bigger bucks. We knew that the Exxon Corporation made venture investments, and that corporation seemed to have a good balance sheet and a lot of cash. So we made an appointment with the Exxon guy in New York who handled that sort of thing and flew to New York. We arrived early in the evening the day before the meting, and went out for a really nice dinner. We decided to celebrate this big deal we were going to close in the morning, so we got a bottle of really fine (and expensive) wine. When we returned to the hotel, there was a message from the Exxon guy that said he had to leave town, the meeting was cancelled, and that he would call us in a few weeks. That was an expensive sales call.

We weren't discouraged. Following that, we got turned down by the Mayfield Fund and Idanta Partners and several funds didn't even return our calls.

But we still weren't discouraged. Money wasn't the only thing that we needed. We needed a disk, and let me explain that. In a rigid disk drive in those days the data was magnetically recorded on an oxide coated aluminum disk. There was a great deal of technology and a lot of tooling money involved in producing magnetic disks. We needed a commitment from a magnetic disk manufacturer to develop and manufacturer a disk that was a different physical size from any in the industry. It would require a manufacturer to not only spend a lot of money on developing the disk, but an even greater amount in tooling for production. The total dollar requirement made our requirement seem small.

So first we flew to Minneapolis to see the 3M Corporation. The 3M people were very interested in the project, but they couldn't do anything because our schedule was inconsistent with their view of reality.

But they were really nice people and agreed to help our effort to get the company off the ground by cutting down some larger disks to the required 5¼ inch size we needed. And even though the center hole of the disk was larger that we could tolerate in actual use, the disk should serve as a good visual aid.

While we were waiting for the 3M sample disks, we called on Memorex, but they never called us back. Within several days, 3M hand-delivered 6 disks samples to me in California, just to help us get going.

With the disk samples in hand, we called on Norm Dion, president of Dysan Corporation in Santa Clara, a magnetic disk manufacturer. I handed Norm one of the sample 5¼ inch disks and he just held it and stared at it for what seemed to be hours (probably 15 seconds). Dysan was just getting into production on an 8 inch disk, having manufactured 14 inch disks for several years. Finally Norm said, "You know, 8 inches was the wrong size." I figured we had him at that point. He saw the tremendous future in what we wanted to do, and agreed to develop and manufacture the 5¼ inch disk.

Then he asked on how we were doing on getting financed. Not wanting to show any weakness, I told him we expected to close something soon, trying to keep my voice from cracking. He said that was a shame since he thought it would make a good package for Dysan to funs our development effort as well as commit to the disk.

We quickly saw the wisdom in this and, on November 14, 1979, six weeks after we put our plan together, Norm gave me a check, we shook hands, and we had a deal.

We had always planned to get the lawyers to document the deal, but we never got around to it since it was never really necessary. That is, until we raised a million dollars of venture capital the following June. Venture capitalists don't like handshakes, so before they would give us money, we had to document the deal. By that time, we had already spent the money, anyway. The total venture capital put into Seagate was only 1½ million dollars, by the way.

About the same time as we shook hands with Dysan, we found our second believer; in, of all places, Scotts Valley, California. A local contractor, the Stekoll Development Corporation, read our plan and decided we could do it. He agreed to put a second floor over his office area to get us going (and do it in 2 weeks), build a lab in some storage space downstairs, and start construction of a 32,000 square foot permanent facility in the same industrial park.

We moved into our office space and started design effort on December 1, 1979, about 8 weeks from the time we got out plan together.

But it was tough to find more believers at that time. We had 8 people in the loft of a suite, and we needed to place orders for parts; some big orders.

We knew we had to get magnetic heads on order quickly so we called the manufacture's representative. I told him we wanted to buy 100,000 magnetic heads (at the time this was about a $2 million dollar deal). He said he'd call on us. Where are we located? I told him we were in Scotts Valley, California, but he had never heard of it. I told him it was in Santa Cruz County, over the mountain from San Jose.

I said after you come down out of the mountains on Highway 17, you turn on Santa's Village Road. Then you go for ¼ mile and turn left at Leo's Liquors. Then you cross a little bridge and go to suite C in the only building there. And we are up above suite C.

So he repeats the directions. "Let's see now. I turn off on Santa's Village Road, turn left at Leo's Liquors, go over a small bridge, go to suite C in the only building that is there, and you're up above suite C. Is that right?"

"That's right," I said.

"And you want to buy 100,000 magnetic heads?"

I expected any minute for him to say, "Come on now, who is this?" But he didn't; and he came to see us and accepted the order. But it was tough with vendors in the early days.

We completed our product development in 5½ months and showed our product in a hotel suite at the National Computer Conference in Anaheim in May of 1980. Actually, we showed 20 units – all with die castings (we needed 20 because all of them didn't work all the time). We got orders during that show including a $200K prepayment, and began shipments 6 weeks later in July of 1980. We shipped 50 units our first month, and by October we were shipping 10 units a day out of a 1000 square foot lab.

In our first full operating year, we did about $12 million in revenues and made about $1.8 million net profit. Profit margins have never been that good since.

Things went so fast that we had an initial public offering of our stock only 22 months from when we started.

A funny thing happened when Norm Dion of Dysan, who was on our Board of Directors, read the first draft of our prospectus and discovered the Seagate owed Dysan over 1 million dollars for disks we never paid for. He checked with his finance people and discoveres they hadn't pushed us because they thought we were a division of Dysan. Norm was really mad, but cooled down when we paid him back out of the IPO proceeds, with interest.

Truly, entrepreneurs in the fast lane, and this is but one of many great start-up stories in the country – certainly there are a lot more.

But what really makes these great opportunities? The availability of capital? Certainly. But I really think it has more to do with the changes in our society. Let me talk a little about that.

When I was working at IBM, the corporation organized a science advisory board made up of a group of very distinguished scientists from very distinguished universities. This group met periodically with IBM management and senior technical people to give us the benefit of their wisdom and learning.

I was quite fortunate when in the 1960's I was invited to a luncheon with the science advisory board in San Jose, along with other senior technical people from the lab.

Following lunch, the IBM host asked the members of this advisory board if they would each comment on the terrible unrest that was going on in our universities, and the apparent change in behavior of all our younger people.

If you don't remember or weren't around at the time, the 1960's found a lot of our young people in jail for acts against the public policy. I recall one columnist writing that while driving down the road he saw a sign that said "Free Firewood," and his immediate thought was: who is this guy firewood, and why is he in jail?

Anyway, each of the 6 or so distinguished scientists addressed the subject.

Norbert Weiner began and expressed great disappointment in our youth with their erratic behavior, and concluded that we were going downhill. The following speakers expressed the same disappointment, and offered theories as to why the behavior, and proposals for fixing it.

The opinion was generally unanimous until the last distinguished scientist spoke. I can't recall his name but I can picture him clearly. He was a world-renowned mathematician, long since retired from his position at Columbia. This quite elderly, gray-haired gentleman said that what was going on with out young people was the result of a change in society that had begun – and that he was both pleased and excited about it. He mentioned individualism, opportunity, creativity, and a true thinking and nourishing society. He said we could close our eyes and not watch the change, or open our eyes and participate in the change – because it was changing anyway. And he had no fear of the future.

(I thought at the time – "Easy for him to say; the old bugger is in his 80's and won't be around when these young crazies are running the country.")

But you know, the old guy was right on. We were seeing an expression on individualism as a result of a change in society that had begun and is still in process.

We've moved from a mass industrial society to an information society, with much more profound impact that the 19th century shift from an agricultural society to an industrial society.

And I think a part of this change has been a significant trend toward de-centralization.

We've moved to an age of the individual. Whereas the strategic resource in the industrial society was capital; the strategic resource in the post industrial information society in knowledge and data (and that's not only renewable, but it's self-generating as well).

And this, I believe, provides for the great entrepreneurial activity in the United States today. Because the strategic resource is now what we have in our heads, access to the system is much easier. I believe that not only will we see an impressive increase in the creation of small businesses, but if large institutions are to survive, they will restructure to encourage entrepreneurial activity within their institutions, and certainly in a decentralized environment.

In 1950, 65% of the people working in the country were working in the industrial sector, and only 17% in the information sector. Today, I believe those percentages are more than reversed.

The number one occupation in the country today is clerk; replacing laborer; and farmer before that. Farmer, laborer, clerk; a brief history of the United States. You might want to contemplate what will come after clerk. It has been suggested that it will be either soldier or poet. I'm not sure which one I'd bet on.

And this age of the individual has brought decentralization. We see large airlines collapsing while new local and regional airlines are beginning.

Large, general purpose instruments are not in tune with the times. We see large circulation, general purpose magazines folding while thousands of special interest magazines are being published.

We see a great umbrella organization like the American Medical Association getting weaker as the groups within it – the pediatricians, surgeons, etc. – are getting stronger, along with the county and local medical groups.

We now have more people contributing to special interest groups like "Save the Whales," than contribute to the umbrella democratic and republican parties combined. I think the two great American political parties now exist in name only. We have a congress filled with independents.

I think we'll see new political parties organized, but they will be more regional than national.

We see local consensus being sought on questions that have never been brought to the political process before. There have been many votes on where we can and where we cannot smoke; using or not using public funds for abortion; whether we should continue to recognize certain third world countries. Some time ago down in Long Beach, they voted on whether or not to have an oil tanker terminal and then later on, the color of their street lights.

We never voted on these kinds of things before. It's a part of what the political scientist would call "direct democracy," but I see it as decentralization and a part of the change in society that has led to the great number of opportunities for new leaders today.

The great new age of individualism and special interest groups also has found a lot of jobs for a lot of lawyers, who are misusing our legal system. But that's another story for another time.

Entrepreneurs are leaders; and followers make leaders, not the reverse. And in the old Taoist model of leadership, "Find a parade and get it front of it," in this new, decentralized information society, our entrepreneurs are finding much smaller parades, but a lot more of them.

And boy, do I like parades.

Thank you for your kind attention.