This morning I would like to take you on a picture tour through some of the packing houses in California and Arizona. Our engineering group represents approximately 106 plants and that means we have approximately 106 different ideas from managers. We have about 8,500 growers and that means that we have approximately 8,500 different ideas as to how things probably should be done. So, this morning, I would like to preface my remarks with the fact that you are hearing one Californian's point of view.

I would like to show you what we are doing now and what we anticipate for the future. I am not going to give any credit lines to companies who are selling machinery or that which has been developed by Sunkist--no commercials.

Figure 1: I am going to show some harvesting equipment because we feel, for too long a time, the packing house has been operated too independent from the harvesting operation and too independent from the processing operation. You are probably aware that most of our processing operations in California, due to the very high costs, is usually not too profitable and we like to ship fresh. We need to get a premium price due to our long distance to market and our higher costs. We feel that harvesting, which is now our largest single cost, needs to be brought into the picture.

We have tested a number of machines. This happens to be one built in Missouri. You can see the top which more or less rakes through the tree. This shows a clever material handling system of bringing the fruit down into bins in the bottom, but I would have to say this type of machine has not been very satisfactory in
California for two reasons. One, it is hard to get this device through the tree and get all of the fruit, and secondly, we get too much injury. We like to handle our fruit with tender loving care. I didn't say we did; I just said we like to and this is a little too hard on the fruit.

Figure 2: This shows one of Sunkist's latest developments which we call a butterfly platform. We have four pickers on the machine. One in each of the corners and two on the ground to make up the system. Normally, this machine would be self-propelled. However, to cut development costs, we are using a tractor to pull it. In this case pickers are using a bag. They dump onto the belt and the fruit proceeds through a foam lowerator into bulk bins. Normally, the machine would pick up bins in front, pass them through the machine and out the back.

We have recognized from the beginning that this type of machine cannot reduce our cost dramatically. As a matter of fact, we would be happy to get to the break-even point. The best we can do is provide a 30% to 35% increase in productivity and that means we can't spend more than $2,000 per man to accomplish this. This particular machine takes advantage of two facts. First, that our picking cost is high when we use a ladder. We have topped most of our lemon trees to avoid ladder work. We plan to use this machine without increasing our picking costs above six feet. We also plan to let the trees grow 2 feet higher to get more production.

This machine takes into account the fact that you can compress a citrus tree about two to three feet. The wings, which normally are folded up, fold down and the push in towards the center of the tree thus eliminating the need for an inside hand rail. You get a feeling of confidence that you will not fall and can work unrestricted. We plan to put some rails on the back side to keep anyone from stepping off the back. So far, no one has fallen but we think it would be a good idea.

Also, there are some "diving boards" or "ironing boards" in each wing that will move into the center of the tree so the picker can get all of the fruit. This machine is under test under commercial conditions.

Figure 3: This shows the sponge lowerator that I mentioned earlier. Maybe this is a case of serendipity. We had used this device to lower the fruit into the bin but we hooked up the 220, three phase motor backward and threw the fruit out of the bin. So we may have a new elevator design. There are several occasions when we do not have room for a bucket elevator. This device takes less space. An interesting point about this device is that the fruit does not rotate.
Figure 4: We have run test fruit through this up to 34 times without significant injury. I think you see the potential of being able to lower the fruit or raise the fruit or turn it a right angle, or put it almost anywhere you want it. It might be possible, by changing material from rubber to some other material, that we might be able to use it as a dryer.

Figure 5: When we were all through with the lowerator, with all its moving parts, someone got the bright idea of stretching screen door springs across a frame. Then, over the screen door springs, placing foam insulation which is normally used in piping. We now have something similar to a Japanese Pachinko machine. Fruit falls in the top and works its way down.

Figure 6: This is a sketch showing a machine which is under construction at the present time. This is a three level machine. We have a total of six men on this machine and then two working on the ground. The machine also requires an operator. It will pick up the bins in front, pass them through the machine.

Ideally, we should work on hedgerow trees because we wouldn't need to go to the expense of having the operator move in and out. Some growers believe that hedgerowing is a good way to plant. They are not there yet so we need to build an intermediate machine that has the flexibility to move in and out.

Figure 7: This shows the bottom level of the three level machine. In this case we are using field boxes because we did not want to go to the expense of rigging up a bulk bin carrier.

There are two or three features about this machine that are a little different from any other harvester that I have seen. Number one, it is a continuous motion machine. It does not stop from tree to tree. It takes us from a batch process and puts us into a continuous process. A very important point for the poor picker. A picker that is adept, can usually pick about twice as much as a poor picker. He is usually quite intelligent. He is usually good with his hands and he organizes his work. If you try to devise a system to improve on Willie Mays' batting you are going to have trouble. If you take a man that doesn't know how to bat you can show some improvement. If he doesn't know how to pick and you put him on a machine like this, and organize his work, you can get phenomenal increases. A major problem is that the kind of people that will show a large increase on this machine aren't particularly good employees.
Another feature of this machine is that it has two positions on each side. They telescope in and out. Let's assume that the tree on the right hand side has been pulled, there is nothing there for the man to do. He can now cross over and work at this station on the opposite side. This is a very key point in a multi-man machine. You shouldn't have men waiting while the others are working. Another important feature is the system used for conveying fruit. It telescopes in and out and as the platform goes into the tree. You can see that the slope on this telescoping device will lessen so that it doesn't make any difference whether it is way in or way out, the speed at which the orange comes out is about the same.

I don't know how closely you have watched pickers. In California, they will put a bag in the front and use their chest as a bouncing board to bounce the fruit into a bag. All former attempts that I have seen to put fruit into some sort of hopper has turned out to be a failure because he spends too much time looking for the hopper. This seems like a very minor point, but it is important.

There is flexible cord across the front. This means that the man can reach into the tree with very little to restrict him. The material can flex and mold to his body. He can now throw the fruit against his chest similar to a bag. This is one of the reasons that we have increased picker productivity.

Figure 8: This is called our undramatic harvester. If we build a harvester like the one we have just seen, that costs $15,000, it gets good publicity. A three dollar clipper doesn't.

In harvesting lemons the picker wasn't accurate enough to put the clipper right where it needed to be so it required a double clip. He would cut the stem about half an inch up from the top of the button and then as he was placing it in the bag he would cut it again. This takes skill. One of the fellows, about eight or nine years ago came up with the idea of using a little gage up front. All you need to do now is place the clipper over the stem and push down until it stops and then clip. This did two things. It increased productivity about 5% to 10% and it allows a relatively inexperienced picker to do a good job.

One of the fellows came up with a bright idea on orange clippers. Approximately 10% of the population are left handed and we decided to make a left handed clipper. We started working on it, and you guessed it, we've been using a left handed clipper for 30 years. This may sound silly, but it is true. The orange clipper has a sharp edge that inpinges on a dull anvil. When you squeeze your hand to clip, the anvil pushes into the sharp edge. This is equivalent to laying a knife on a table and trying to push a loaf of
bread through it. By just sharpening the other edge you reduce the cutting force by 25%. With the cutting edge reversed you also reduce clipper cuts. The anvil now allows the clipper to slide down the stem to the button.

Figure 9: This is a typical method of transporting bulk bins in California, a highway straddle carrier.

Figure 10: This is a field straddle carrier that places the bins in a position at the headland for transport into the packing plant. There is a hoist to lift the bins from the top.

Figure 11: This is one of our newer packing houses in Arizona. Our industry went through a period of building packing houses at ground level. We have since learned, due to unitization and cargo containers, that this may not be the proper way to build. The ideal packing house should be built on a slope so the field operations and material coming in from the field would be at ground level and the packing house would be at dock level.

Figure 12: This is a new degreening room. We've moved toward large rooms that hold approximately 6,000 California field box equivalents. This Figure shows one of three different systems that we use for cooling in the summer or adding heat in the winter.

Figure 13: With very large rooms we ran into a problem. We were unable to count the bubbles in the conventional ethylene trickle system fast enough. We designed a system where the ethylene comes into a flow meter for each room.

Figure 14: This is a view of fireproof polyurethane insulation. We read the advertisements--fireproof, doesn't smoke, etc. We put this into a plant in Yuma and an arc welder came in and was doing some welding in the corner of the building. It burned in about three minutes. So, just a word of warning to you if you plan to use polyurethane insulation, be extremely careful. After the fire we ran some tests. We were curious as to what they meant by fireproof so we took some polyurethane insulation into a laboratory and placed it in a test chamber about one foot square. We lit it and it singed the ceiling of the lab.

Figure 15: This shows one of our typical bulk handling layouts. The bins come in at the far end and they are stacked three high. They are unstacked, dumped, fumigated, and then stacked again. We have moved the dumping operation out of the packing house. It is dirty and dusty and our weather is good enough so that we can do it.
Figure 16: One of the new methods in some of our packing houses is the foamer. This makes use of dowicide and soap. The material foams over a screen and the fruit is brushed. It is then rinsed and all of the free moisture is taken off by sponge rollers.

This system has been very helpful in lemons. We store our lemons. When they come out of storage we do have occasional decay and the foamer is a good way of cleaning up the fruit before we pack it.

We've conducted several laboratory decay tests on oranges and have found foamers to be of little value. We have also checked commercial shipments and have not been able to find any difference between the foamer and the standard tanks.

Figure 17: This shows one of our new grading tables. As we mechanize the packing end of the line we find that we need much better grading equipment. We will no longer have the packer to check that occasional mistake that gets through.

In our older grading tables a girl would look at the same fruit that the other 17 girls looked at. She might be waiting for the other 17 to do their work and they were probably waiting for her to do the work. The tables have been changed now so that the fruit coming in is sheared off so that three or four girls work on a given batch of fruit. Each girl has a very specific assignment.

Figure 18: In this figure you can see that the grade foreman can come in the back, theoretically without the girls knowing it, and check the work of each individual girl.

Figure 19: This shows the electronic color sorters that we're using in the lemon business now. The fruit comes through a shuffle-board into an indexing device. The fruit drops through a scanning eye.

Figure 20: After the fruit passes through a scanning eye into a rotating wheel, the memory system drops it into one of four lanes.

We have been working on an automatic grading device that we feel has potential and we would encourage others to work on the problem too. We are working on a modular system and hope to check the fruit for internal qualities. Another module is planned that will check for blemishes; there could be another module that would check for color; there could be another module that sizes. Each module will relay its information on each individual orange or lemon into a small computer composed of integrated circuits.
Figure 21: This is a cold process stamping machine.

Figure 22: This is a volumetric lemon sizer. I believe that you have a similar situation in oranges in Florida that we have in California. It seems that the dawn hasn't really appeared with respect to the importance of volumetric sizing, and how much money it can make for a shipper.

Figure 23: This shows the principle of volumetric sizing. There are four points of contact which are really gaging the radius of curvature of the fruit. The radius of curvature is in direct proportion to the volume.

Figure 24: This shows a volumetric universal sizer for oranges and grapefruit. The fruit is supplied at this end and gaged on the same principle as lemons. This sizer is now set automatically. If you want to switch from oranges to grapefruit, or vice versa, instead of turning a crank by hand you simple push a button and the gear boxes are pre-programmed to set automatically in about 20 seconds.

Figure 25: This is a pack table used for packing oranges. A later slide will show automatic packing machines that plug into this.

Figure 26: Let's switch over to lemons for a moment. We have been volume filling lemons for approximately 15 years.

Figure 27: This shows a close up of one of the units. The fruit depresses a counter on the bottom and the sponge rubber roll keeps the fruit from bouncing and getting a double count.

Figure 28: This shows a semi-automatic packing machine. I feel that volume fill in lemons is a very practical method because the average approximate number of lemons in a carton is 172. The average number of oranges in a carton is 90. They are roughly twice as large. If you pack cranberries into a carton you probably will not place them. On the other hand, if you are packing basketballs, it may be wise for you to place them.' The size relationship is very important.

Figure 29: Another view of the pattern packing machine.

Figure 30: This machine places fruit in a pattern that you cannot tell from a hand pack. There are heads equipped with rubber suction cups. One head places fruit into the carton while the other picks up a new layer. The machine, at this time, requires an operator. It is completely automatic as long as the suction head
does not miss the fruit. If it misses the fruit the machine senses it and the machine will stop until the operator can open the safety gate and place an orange into position.

A typical packer in California without the machine will average about 300 cartons per day. With the machine in commercial operation we have been averaging 1,200 cartons per day. Our actual labor costs on the machine are slightly under 2¢ per carton.

We have done a number of injury and decay tests on the pack machine and there is less decay than with hand pack—not a significant difference, just a slight difference.

Figure 31: This is the recording end of an electronic counter that can be placed over a belt. It counts the fruit as it is conveyed, and it works well. The device reduces the time required to change from lot to lot. I would predict a very good future for this counter, at least under California conditions.

Figure 32: An item starting to catch on in California is carton formers. There are two companies that have commercial models available that will handle a telescoping carton. One unit does not seal; the other unit seals the bottom. As with all new equipment, they are still in the process of debugging them.

Figure 33: Most of our packing houses have sealers with closed glue systems. Many are available now. This happens to be one we developed at Sunkist several years ago. The hot melts are beginning to come into the picture and we are concerned about them. They are an excellent sealing device but users have a tendency to reduce the quantity of glue too much to reduce their costs.

Figure 34: This is an automatic palletizer. The palletizers alone might sell in the $18,000 to $25,000 range. I'm sure you've seen automatic palletizers in other industries so they are really not new. A little new to the citrus industry, however.

Figure 35: The conveyor and accumulating system going into a palletizer is usually much more expensive than the palletizer. For example, if you're running nine sizes in three grades, there are 27 variables and you will need considerable storage area. Our experience has shown that we should not palletize automatically on 100% of the fruit because there are too many variables. We try to handle the majority, possibly 80% of the total.
Figure 36: This shows a palletized load moving into a cargo container. In most of our tests in cargo containers and with unitized loads we have had exceptional success. This shows great promise for citrus. We have been concerned about having to raise the quality of our carton and we have been concerned about costs. By putting the carton into a container, we reduce the number of handlings and our cartons arrive in excellent condition, just as they are.