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This paper reports on a meeting organized by ATI and Lutheran World Relief in Nairobi, Kenya, February 20, 1989. The purpose of the meeting was to discuss the Bielenberg sunflower seed oil press, a low cost ram press introduced originally in Tanzania through two ATI projects. Issues discussed included agricultural extension, types of seeds being processed, engineering designs, and ideas for coordinating activities in the future.

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Proceedings of the Meeting

"OILSEEDS AND THE BIELENBERG RAM PRESS"

20 February 1989

Norfolk Hotel
Nairobi, Kenya

Organized By:

Appropriate Technology International

and

Lutheran World Relief

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AGENDA
SUNFLOWER OILSEED MEETING
NORFOLK HOTEL, NAIROBI
20 FEB 1989

8:30 - 9:30	COFFEE AND REGISTRATION
9:30 - 10:00	OPENING COMMENTS AND INTRODUCTIONS MICHAEL O'DONNELL, A.T. INTERNATIONAL (WASHINGTON) (EACH PARTICIPANT WILL BE ASKED TO GIVE A BRIEF DESCRIPTION OF THEIR INTEREST AND WORK IN SUNFLOWER OIL)
	(THE FOLLOWING 45 MINUTE SESSIONS WILL CONSIST OF 15 TO 20 MINUTE PRESENTATIONS FOLLOWED BY QUESTIONS AND GENERAL DISCUSSIONS)
10:00 - 10:45	ELCT PROJECT, TANZANIA LYNN SCHLUETER, DALLAS GRANIMA
10:45 - 11:00	COFFEE BREAK
11:00 - 11:45	ENGINEERING CONCERNS MARTIN FISHER, ACTION AID (KENYA)
11:45 - 12:30	DEMONSTRATION OF BIELENBERG PRESS HUGH ALLEN, CARE; MARTIN FISHER, ACTION AID
12:30 - 2:00	LUNCH (THE DELAMERE ROOM, BUFFET)
2:00 - 2:45	SUNFLOWER SEED RESEARCH DR. JUMA LOGOGO, DR. S.S CHINA, DR. CARLOS ZULBERTI EGERTON UNIVERSITY
2:45 - 3:30	PLANNING FOR REGIONAL COORDINATION
3:30 - 3:45	COFFEE BREAK
3:45 - 5:00	GENERAL DISCUSSION

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OPENING COMMENTS AND INTRODUCTION

Michael O'Donnell, Appropriate Technology International (ATI)
Hans Hoyer, Lutheran World Relief (LWR)

In November, 1984, ATI and Lutheran World Relief launched a program to help Tanzanian village groups establish, own, and manage small-scale sunflower seed oil extraction industries. The enterprises were to use low-cost hand-operated presses manufactured in the town of Arusha. In addition to generating income and creating employment among Tanzania's rural poor, the project was intended to increase the availability of reasonably priced cooking oil, expand the market for sunflower seed and enable small producers to process cooking oil locally. The project was funded by ATI and LWR with support from the Government of Tanzania and USAID local currency resources.

The Village Oil Project initially disseminated three types of oil presses. The first two presses to be introduced, a 20-ton and an 80-ton scissor jack press, were developed by the Institute of Production Innovation (IPI) at the University of Dar-es-Salaam. Made of common mild steel and capable of producing 2 and 8 liters of sunflower oil per hour respectively, the presses were locally manufactured, relatively low in cost, and easy to use and maintain. The IPI presses were more appropriate in many respects than the more expensive diesel or electric powered expellers (occasionally used in towns) and time consuming traditional extraction methods which involve threshing, crushing, and boiling the seed.

In late 1985, however, a smaller, manually operated ram press was designed by ATI staff engineer Carl Bielenberg to fill a market niche not served by the two larger, heavier IPI presses. The ram press was cheaper, lighter, and easier to construct than either of the IPI presses, and did not require ancillary pre-processing equipment such as a scorcher and decorticator (dehuller). Because of its lower cost, and because it proved more practical in rural areas than the large, heavy, and relatively costly IPI presses, today the ram press is the only press being disseminated by the Village Oil Project. The interest in this technology has been widespread and we often say that "it has taken on a life of its own."

The history behind today's meeting is interesting. Because ATI and LWR knew that several organizations were interested in working with the Bielenberg press, we decided to hold an informal meeting to share information. We expected about a dozen individuals to attend. As you can see, the attendance is three times that number. There are organization represented here today that we had no idea were interested in or had even heard about the press.

We have asked several people to give short presentations. In addition, there will be time for others to talk about their experiences and for questions and answers. The intention of this meeting is to learn who is doing what and to have some idea of what we might be able to do together. There are organizations represented here that have bought the press and many engineers who have been modifying the press with differing results. Thus, we'll be discussing key issues such as agricultural extension, types of seed being pressed, engineering designs, and ideas for coordinating activities in the future.

Lynn Schlueter, ELCT Village Oil Project, Arusha, Tanzania

Our project is based in Arusha under the auspices of the Arusha Diocese of the Lutheran church. The sponsors of the project include LWR, ATI, and the Government of Tanzania. Dallas Granima is the Field Manager of the project. Because of his very important extension work, Dallas was not able to join us today.

Although the focus of our implementation work has been in Arusha region, I have tried to contact other organizations in other places to let them know about the work we are doing.

Arusha region is not the principal sunflower growing area in Tanzania and for that reason we have received some criticism for working there. However, I think that what we have managed to achieve in Arusha region is a good indication of what could be done in even more appropriate sunflower growing areas.

Originally this project was designed to introduce a large IPI or scissor-type press which was being produced in Dar-es-Salaam. When I first saw that press I had my doubts about whether it was an appropriate technology to introduce to Tanzanian villages because it was very large and heavy. About this time, Carl Bielenberg came to Arusha and in a matter of a few days invented the ram press.

The first day Carl got the press operating we both were very excited. We also discovered that it worked even better without first decorticating the seed. This was an even more exciting discovery, because it eliminated the need for additional machines.

Our enthusiasm was not totally matched by others, however. We continued to work with both the Bielenberg press and the IPI presses. A machine shop in Arusha manufactured the first ten Bielenberg presses for us. Unfortunately, both the welding and alignment work were of poor quality and caused numerous problems. In spite of this we were able to get the presses placed in villages and people started using them with positive results.

We first took the presses to people who were already processing sunflower seed using the flotation or traditional method. In this process, you basically pound the seed for several hours and

boil it for several hours and eventually you get some oil. The press was very well received by these people.

Carl initially mentioned that many changes could be made to this machine, but advised us to stick to the basic design for about a year, which we did. Meanwhile, we involved other companies in manufacturing the press in order to create some competition. Because the debate about which technology to use was still going on during the project's second year, ATI hired Martin Fisher to come to Arusha to conduct some stress tests on the ram press and the IPI presses. While he was there, Martin also modified the ram press by increasing the length of the handle to obtain more leverage and reducing the size of the cage so that less seed is fed into the hopper each time. He also modified the stroke so that it only comes down to chest level; this eliminated the need to bend over with each stroke. We found this machine could be operated by one person instead of two and this was a major improvement.

Quality control is really difficult. We check all presses before we take them to the field. Some of the machines that were sent to Zambia and Rwanda were poorly made and broke as soon as they were used. Martin had discovered that some parts of the press could not withstand a high level of stress and would break under these conditions. Tanzania is fortunate because the seed available, although not hybrid, is very soft and rich in oil. Even when machines were poorly manufactured, they did not break when using this seed.

The project really gained momentum when individuals were allowed to purchase the press. Originally, the project only sold the press to groups because, based on experience, we knew that when a few individuals in a village learn about a new technology, they often use to it their own advantage, to the disadvantage of others in the community. It was a pleasant surprise to discover that this type of technology encouraged cooperation rather than competition. Because very few farmers are capable of growing enough sunflower to keep this machine busy for any length of time, it is natural for them to work with their neighbors and encourage them to also grow seed.

Two types of situations can occur. A farmer may sell his seed to the press owner -- and receive considerably more money (as much as double) than he could by selling the seed to the government. Most often farmers who grow perhaps five or ten bags of sunflower seed bring their seed for pressing and pay a fee -- similar to the way in which maize mills work in Tanzania. As payment they leave a portion of their oil and/or cake with the press owner. This amount varies and we do not try to influence the arrangement.

Once we started working with individuals and families then things really started clicking. Much more interest was generated and each year we find ourselves placing more presses. The first year we placed 10 presses, then an additional 15 presses the second

year, and now we have about 40 presses in the field. Next year we expect to place another 20 to 25 presses in the field.

Generally, when we go to a new village, we conduct a demonstration of the press at the beginning of the planting season. If people are interested we sell them the correct seed to use and come back at harvest time. Our project offers short term loans at the beginning of harvest when we actually can see the sunflower in the field and we have a sense that people will be able to repay the loan. Sometimes people pay cash for the machines.

Initially in many of the villages only a few people were familiar with the seed we are using. Much of the seed grown was a hard seed which is big and heavy. It is sold by weight to the government so farmers are really not that interested in the oil content. We were then faced with the problem of getting farmers to change from growing poor quality seed to growing good quality seed. I thought it would be a very difficult process but in fact it turned out to be quite simple. Once people see the potential of the good seed they are very willing to try it. It is now being grown successfully and we are seeing almost a 100% turnaround in a matter of two to three years.

If farmers are growing the right seed and are taught how to use the machine properly, then they are basically on their own and no longer need our assistance -- unlike other projects when things come to a halt when the project terminates. I do think it is important for the farmers to receive our help in the beginning. If someone just buys a machine from a shop and doesn't get assistance in growing the right seed, etc., then it will cause a lot of problems.

Once in a while, we sell farmers new seeds. With open pollinating seeds you can save your best seeds to replant for a few years but then you really need to plant new seed.

When a machine breaks down in a village, the owner does not come to Arusha town to get it repaired but has it repaired locally. Machines that have been used extensively have needed the housing for the cylinder re-fabricated and this has been done by simple welding of pipes. This machine is so simple that it can be repaired in any place where welding equipment is available.

The price of the machine in Tanzania is rising quickly because of inflation. In the beginning someone could recover the cost of the machine by pressing about 30 bags of seed. Now I imagine you might have to press 70-80 bags to pay for it. But the machine still can pay for itself very quickly.

Initially, some people did not know what to do with the cake, but now it is commonly used as an animal feed and there is a demand for it. I've heard it said in some places that cake may be the most important aspect of this project.

One thing that we found with this machine, at least in the Tanzanian context, is that it fits very nicely into the community. It meets the requirements in terms of simplicity; the cost is not a tremendous disadvantage; it's easy to use and repair. It is just simple; you can put the press in a hut at night, take it out the next morning, and start pressing oil immediately. I think it has tremendous potential in Tanzania.

Obviously, people from other parts of Tanzania have come to ask us about the press and we have helped them to get presses and find manufacturers, etc. But we have not promoted the press by trying to sell as many as we possibly could. Instead, we have tried to be very methodical about it and tried to make sure that people get off on the right foot. Now we have a much larger project which can reach out to other areas of Tanzania where the potential is very good.

DESIGNING THE RAM PRESS

Martin Fisher, Ph.D., Action Aid (Kenya), ATI Consultant

This morning I would like to talk about the principal variables involved in the design of the Bielenberg ram press, including such things as piston size, handle length, pivot pin separation, cage dimension and restriction cone shape. I also would like to discuss the theory of oil pressing and point out a few of the advantages the ram press enjoys over other kinds of presses. I would like to explore how the ram press works and look at what is actually going on inside the cage. Third, I wish to examine ways in which to maximize oil output per kilo. We will talk about the effects of mechanical advantage and the cage shape. As far as engineering design is concerned, I will talk a bit about the importance of strengthening certain critical machine components. Finally, I have a few comments on ways to reduce the cost of the machine.

Background and Theory of Oil Pressing

The extraction of seed oil by compression involves either an expeller or a piston entering a cage and generating pressure to force oil out of the seed cake. Experiments carried out on Tanzanian black "Record" sunflower seed suggest that between 1.25 and 1.75 tons/in^2 are needed to get oil out of whole seed. Pressure is defined as the force on the seed divided by the area of the piston. Any increase in the piston diameter will quickly give rise to demands for very high forces. If we have a 2" diameter piston, for instance, we are talking about 4 to 5.5 tons of force; if we have a 4" diameter, we are talking about 16 to 22 tons; and if we have an 8" diameter, we need between 64 to 88 tons of force. By comparison, a good car jack might be able to exert 5 tons of force.

In the case of a batch press, which is the most common kind of sunflower press, very high forces are needed because the cage, for reasons of economy, is typically large. Why? Batch presses require two pressing cycles, one to compress the seed, the other to remove the seed cake from the compression chamber. With a two cycle process, the only way to save time and money is to try to get as much seed as possible into the cage at one time. This, of course, means that the pressing force must be very high. For example, to press undecorticated seed an 8" diameter cage would require at least 10 to 15 tons of force.

Because these forces are so high, most batch presses require some form of seed pre-processing. This may entail decortication, winnowing, rolling (to break the hulls), and/or heating. Once this has been done, the pressure needed to extract oil is significantly reduced, enabling you to have a very big cage. An 8" cage, for example, would not require the 10 to 15 tons of force noted above, but perhaps only 5 or 6 tons. On the other hand, you would now need two or three extra machines to do the pre-processing -- and this adds to the cost of the entire operation.

How the Ram Press Works

In 1985, ATI Engineer Carl Bielenberg designed a press that exerted high pressure (eliminating the need to pre-process) and had continuous throughput (making two compression cycles unnecessary). He also wanted a press that would be small and low cost, and that would not require additional pre-processing machines. The result is the ram press. As you can see in Figure 1, it has a long handle, two pivot pins, and tie arms that join one of the pivots to the piston. When the handle is lifted, the seed falls down into the compression cylinder. When the handle is pulled down, the piston moves into the cylinder, compresses the seed into the cage, and forces some of the seed cake out past the adjustable restriction cone.

What is actually happening inside the cage? As you can see in Figure 2, we are dealing with something known as the "stick-slip phenomenon." As the piston enters the seed chamber, the seed cake already inside the cage is simply being compressed without moving toward the cone. Friction along the walls of the cage is holding the cake in place. After a certain point, the frictional force is overcome and the entire seed cake "slips" so that a portion of the seed cake is discharged.

The sticking is caused by the frictional forces along both the edges of the cage and the face of the restriction cone. Together, these frictional forces counteract the piston force, causing the seed to compress rather than move. This compression will continue as long as the frictional forces are greater than the piston force. However, once the piston force exceeds the frictional force, the contents of the chamber will slip causing some of the seed cake to be discharged. The maximum or "peak" force occurs right before the seed cake "slips" and discharges.

Figure 1
The Bielenberg Ram Press

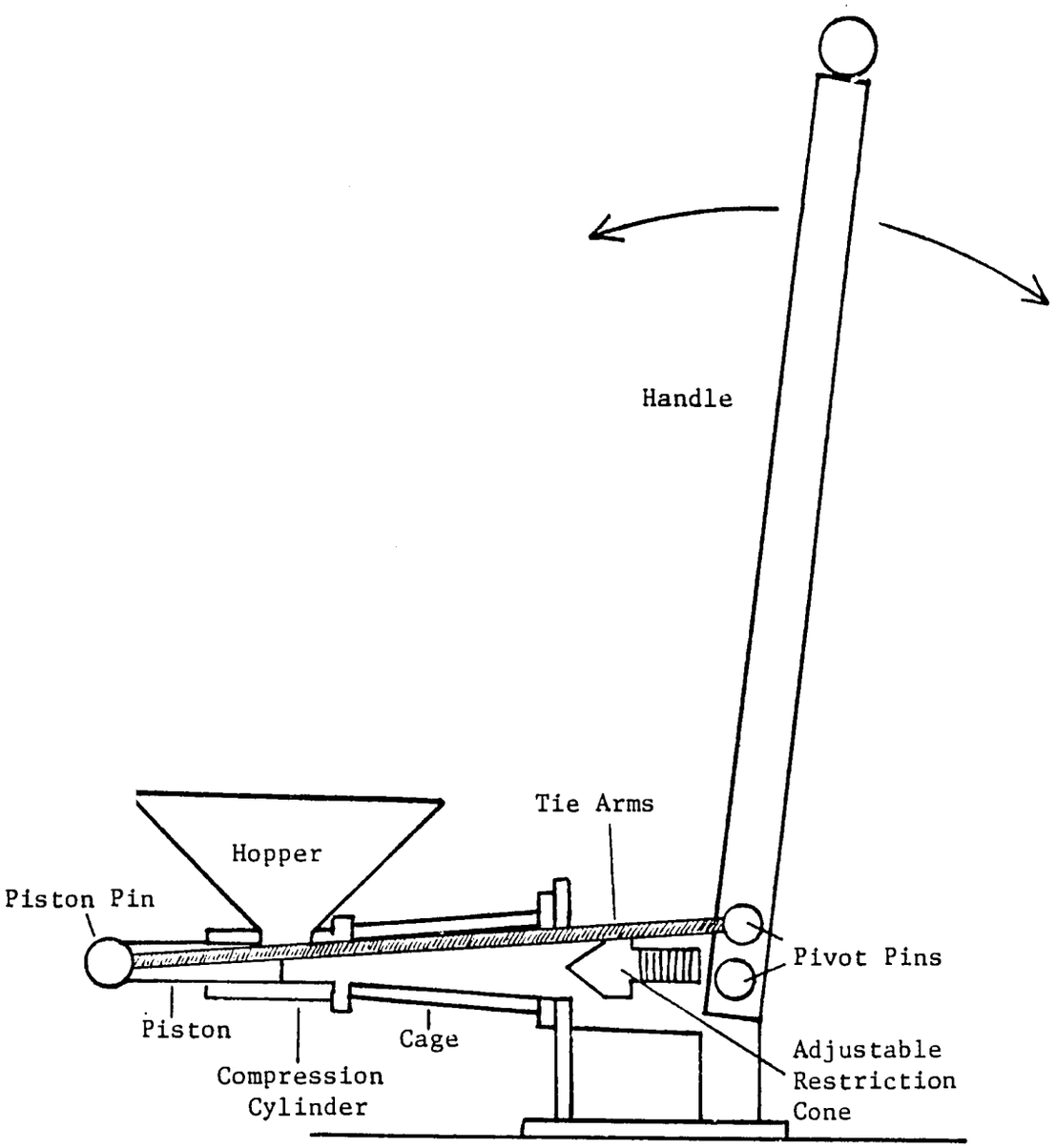
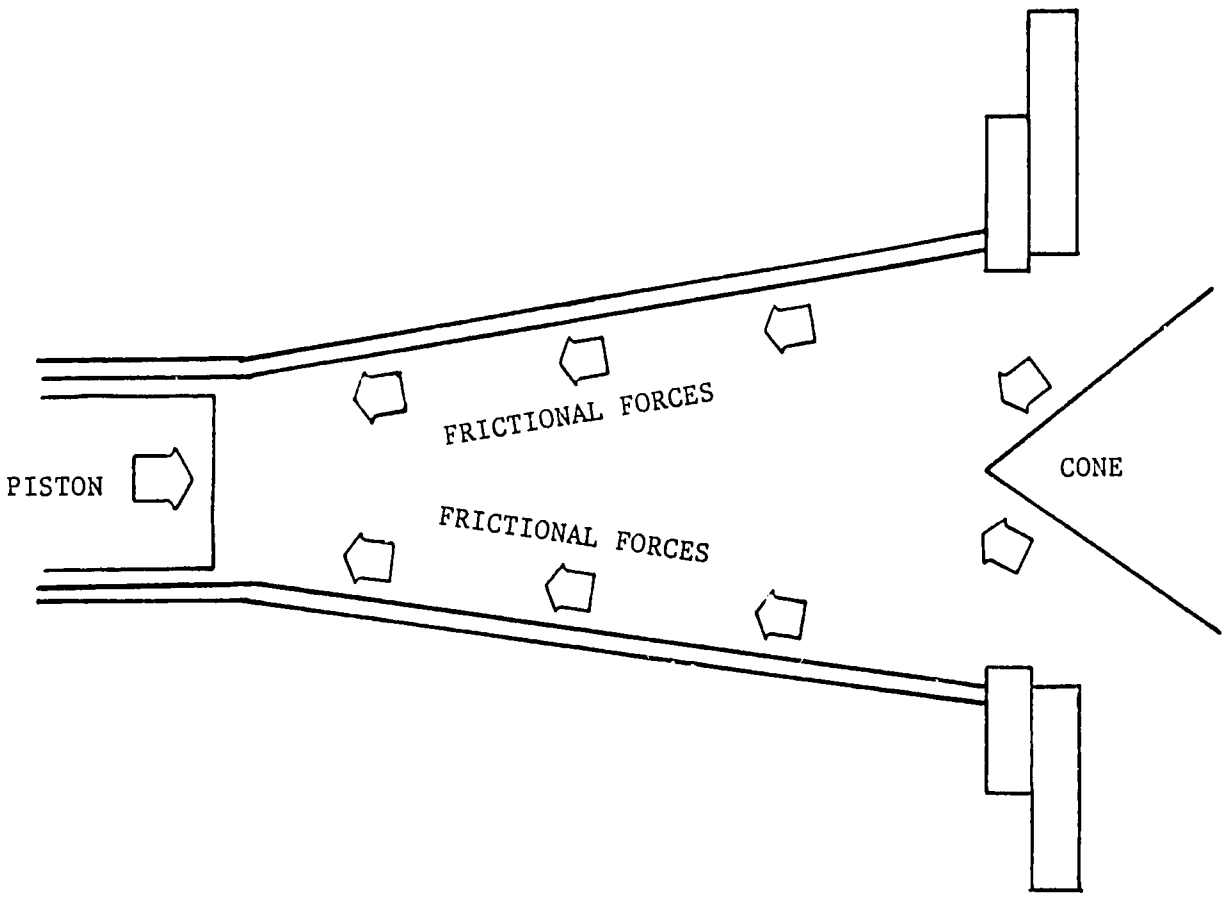


Figure 2
Cross-Section of Press Seed Chamber



The magnitude of the frictional force depends on a number of factors. For one thing, it depends on the particular properties of the seed and how it sticks along the edge of the cage. But more than that, it depends on the exact position and possibly the exact shape of the cone. That is why the cone must be adjusted to a given operator and a given kind of seed. If you have a weak operator, you adjust the cone out so that the pressure required to cause the "slip" (discharge of some seed) is not very great. In this case, because the peak force or pressure is low, you can expect less oil. If you adjust the cone inward, the frictional force increases, so that greater pressure is built up before the "slip" occurs. This way you get more oil.

Maximizing Oil Output per Quantity of Seed

From my own experiments, I have found that the more peak pressure you create, the more oil you expel. Even if that peak is held for only an instant (before the seed "slips), the peak force somehow releases the oil and allows it to flow.

Mechanical Advantage

How do we get a higher peak pressure? In the first place, it can be achieved by obtaining what engineers refer to as a higher "mechanical advantage." The mechanical advantage is simply the force generated by the piston divided by the force applied to the handle:

$$\text{Mechanical Advantage} = \frac{\text{Force Generated by the Piston}}{\text{Force Applied to the Handle}}$$

Mechanical advantage is based on the "lever rule" of physics. To give you an example of the lever rule, let us look at Figure 3. If you wanted to lift a heavy weight, you could do so quite easily by placing it at the end of a long board and lifting it from the other end. The mechanical advantage of this system can be calculated as the length of the board to the pivot point (L) divided by the distance from the pivot point to the weight (l). This is equivalent to the "generated force" (which is the weight being lifted -- W) divided by the "applied force" (which is what you are applying to lift the weight -- ¬). The longer the arm is, the easier it is to lift that very heavy weight. With a very long arm, for example, you could even lift one ton quite easily. The ram press operates under much the same principle (see Figure 4). Our mechanical advantage derives from the fact that we have a long handle (L) and a short distance (l_o) between the pins at the bottom pivot point and the pin connected to the tie-rod, through which we are applying the force. In the top position of the handle, the mechanical advantage is distance (L) divided by the distance (l_o). To increase the force in the press, one needs

Figure 3
The "Lever Rule"

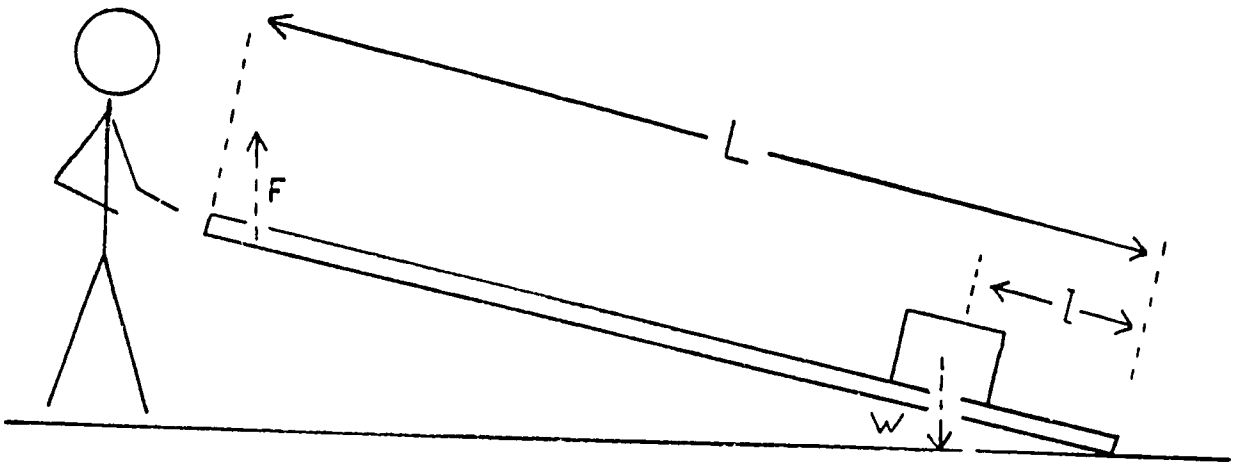
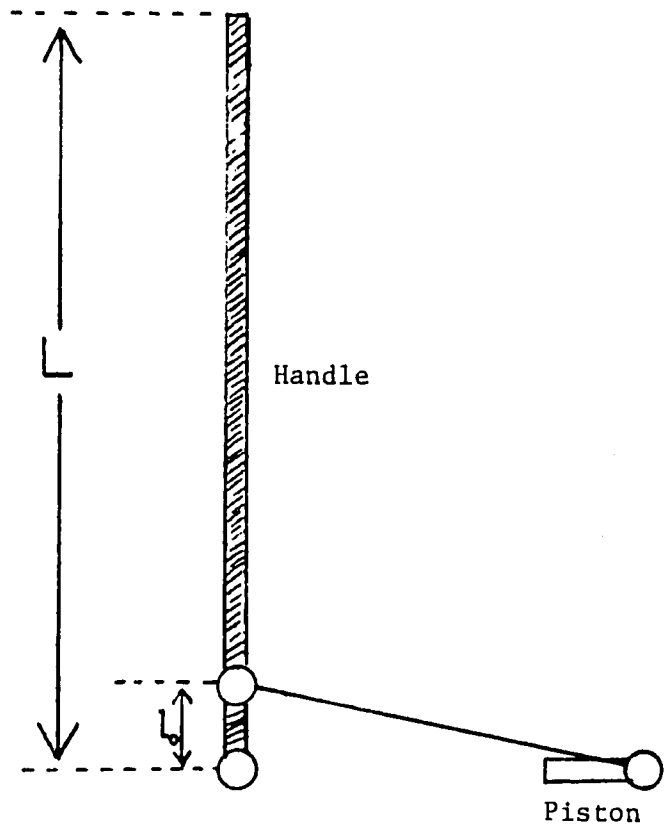


Figure 4
Mechanical Advantage of the Ram Press



to either lengthen the handle or shorten the distance between the pins.

One very important characteristic of the ram press, however, is that the mechanical advantage does not remain constant over the length of the stroke (see Figure 5). At the beginning of the stroke, when the handle is still almost upright, the mechanical advantage is simply L/l_o. But as you pull the handle further down, the effective distance between the pins decreases. When you reach the final position, the effective distance between the two pins (l) is zero. This means that the mechanical advantage becomes very large (L/l) and tends toward infinity at the end of the stroke.

All of this can be plotted quite simply on a graph. If we look at the graph in Figure 6, we see that the mechanical advantage starts at L/l_o with the handle in the upright position and becomes very large by the end of the stroke. For a constant force applied to the handle, increasing the mechanical advantages increases the forces generated at the piston. For example, if you apply fixed force on the piston handle while the piston is at the position represented by point A on the graph, you will be generating a relatively small force. But if you apply the same force on the handle while it is at the position represented by point B, you will generate a much larger force. <u>This shift in mechanical advantage over the course of the stroke is a characteristic feature of the lever and pin mechanism</u>.

Now, if the force required to compress the seed builds up too quickly relative to piston displacement before the press has reached a region of high mechanical advantage, the handle will become too difficult to pull down. It then becomes necessary to withdraw the cone (letting the seed cake come out more easily) which effectively lowers the peak pressure that can be achieved by the press. If you look at the graph in Figure 6, you can see the importance of being more or less toward the end of the stroke before the slip takes place. If the slip takes place near the beginning of the stroke (the point of low mechanical advantage), then not enough pressure will have been built up to squeeze oil out of the cake. If you can reach the end of the stroke, then a very high peak pressure will have been built up and a lot of oil will be squeezed out.

What does this all mean? Let's do a hypothetical experiment with two very different kinds of material. Let's take a sponge and a piece of stiff rubber cut into cubes of equal size (see Figure 7). If we place a 10 kilogram (kgf) weight on the sponge cube, it compresses by, say, 30 percent. If we place a 100 kgf weight on the sponge, it compresses almost to the surface of the table. But if we place the 10 kgf weight on the stiff rubber cube, we see that it barely compresses at all. It is only after we weigh it down with, say, 5000 kgf that it compresses to the same height as the sponge under 100 kgf.

Figure 5
Changes in Mechanical Advantage
Over the Length of the Stroke

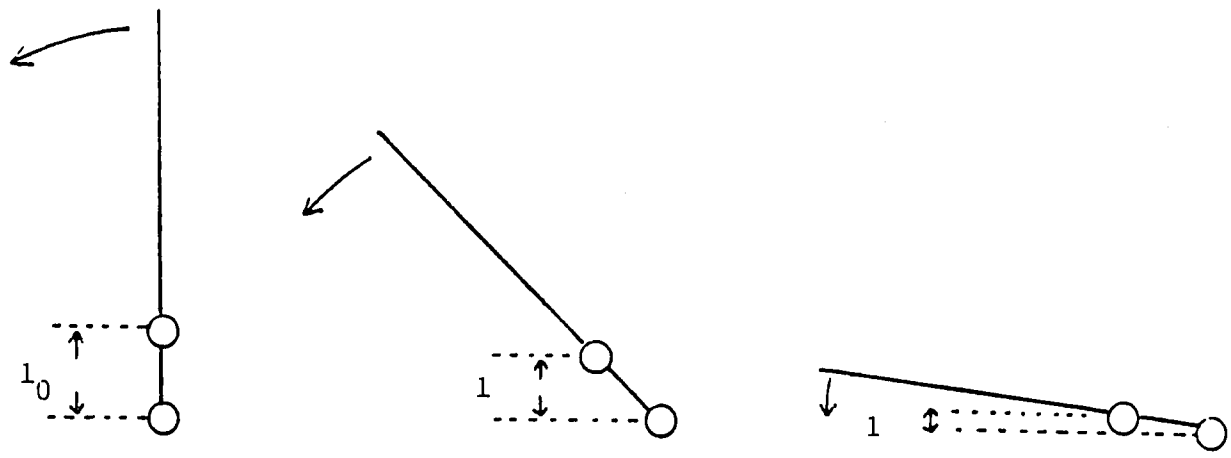


Figure 6
Changes in Mechanical Advantage

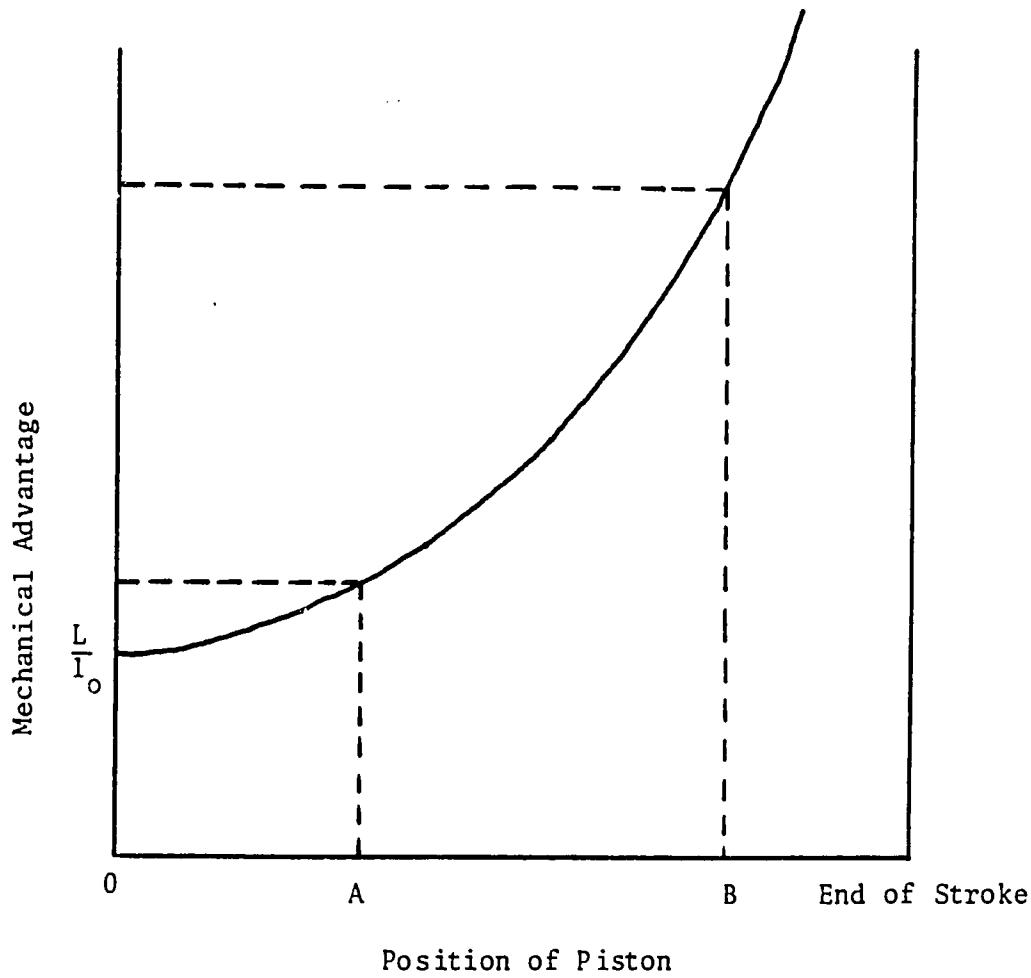
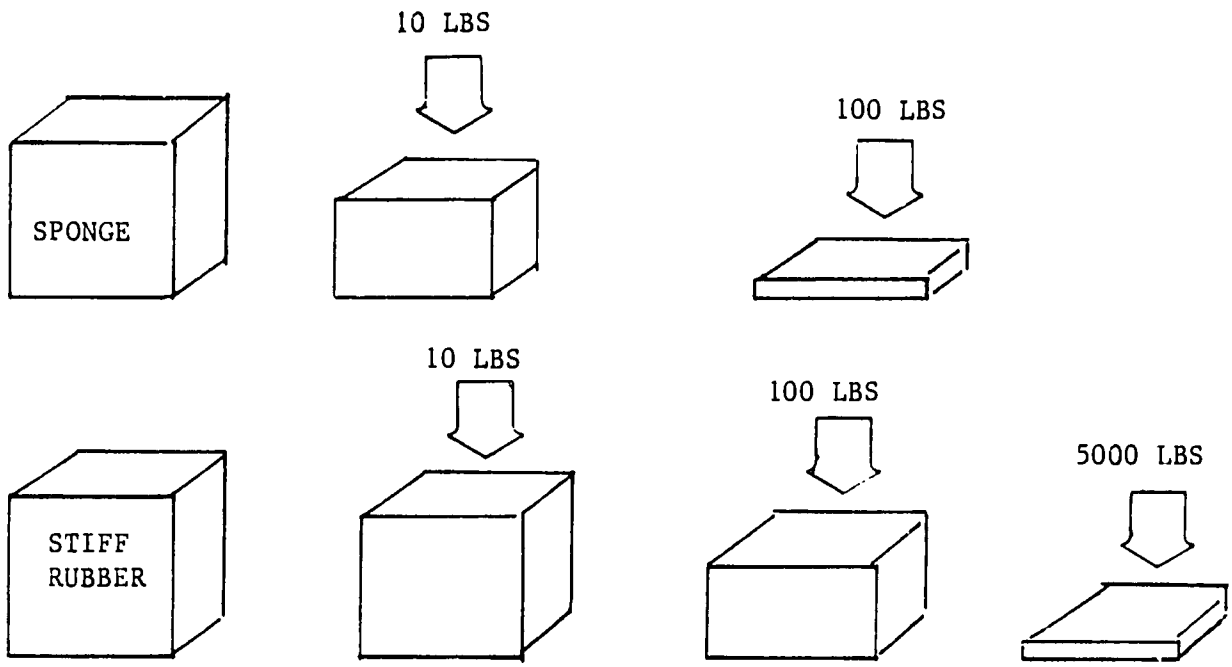


Figure 7
Comparison of Sponge vs. Stiff Rubber



Let us now try to compress these materials in our press. Looking at the graph in Figure 8, we see that for a constant force on the handle, the mechanical advantage curve represents the maximum possible force that can be generated by the piston at any position. Let us plot the force vs. displacement curves for both sponge and rubber on the same graph. In the case of the rubber, we find that 10 kgf of force produces very little displacement (distance AB). The sponge, on the other hand, compresses substantially under 10 kgf (distance AC). Similarly, under 100 kgf, the rubber compresses by only the distance AE, whereas the sponge under the same force compresses by the distance AD.

Seed cakes which react like the stiff rubber are difficult to press because of the low mechanical advantage available at the start of the stroke. It is not possible to achieve sufficient pressure to extract oil unless one applies a very large force on the handle.

With a seed cake which reacts like the sponge, sufficient pressure to extract oil can be obtained using a much lower force on the handle. Where high forces are required (at the end of compression), there is a high mechanical advantage available.

In order to press hard seed cake, one would have to loosen the cone and let some slippage occur, so that some of the material could come out. This will lower the peak pressure (the pressure before slippage occurs) and less oil will be extracted. In the case of the sponge-like seed cake, loosening the nut is not necessary and a high peak pressure and a high oil yield can be achieved.

This means that we want our seed cake to react like the sponge. If it is too stiff, then the force required will build up too quickly and we will have to loosen the cone to let out some of the seed material before we have reached a large enough pressure to extract the most oil. With a sponge-like material, the force builds up more slowly and we have the mechanical advantage where we need it. We can keep the cone closed and reach a high peak pressure to extract a lot of oil.

Cage Shape

How can we get the seed cake to act like the sponge? For one thing, we can taper the cage. If we turn to the uppermost drawing in Figure 9, we can see that compressing the rubber or sponge cube from above causes it to expand sideways as this is the only place available for it to move. If the material is compressed within a straight cage, however, it can't expand sideways at all, so it becomes very hard to compress. In the case of a tapered cage, however, the wider end essentially provides additional space for the material -- seed cake -- to expand. Because each piece is moving into a wider area of the cage as it moves forward, it is allowed to expand. As a result it is easier to compress seed cake in a tapered cage than in a straight cage.

Figure 8
Displacement of Sponge and Stiff Rubber
Under Compression in Press

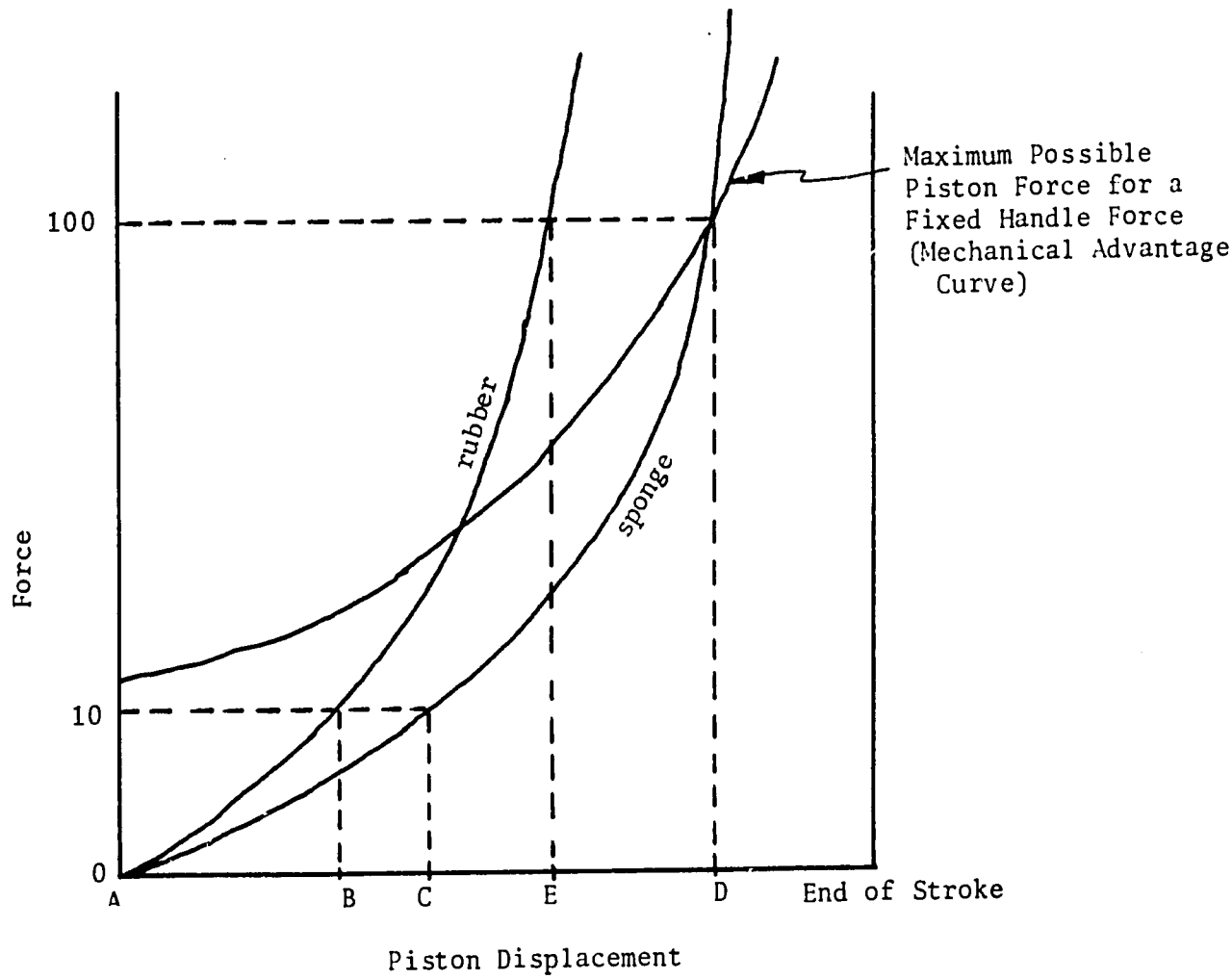
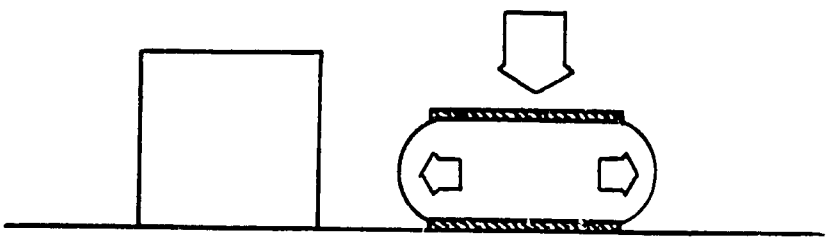
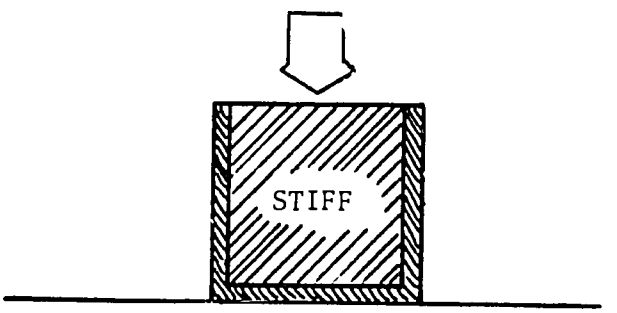
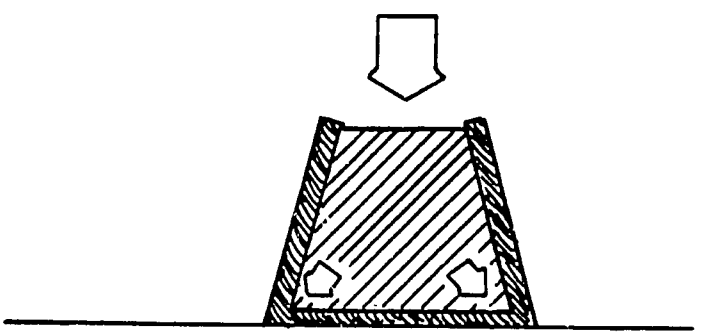


Figure 9
Compression and Expansion of Material
In Straight and Tapered Cages





Straight Cage



Tapered Cage

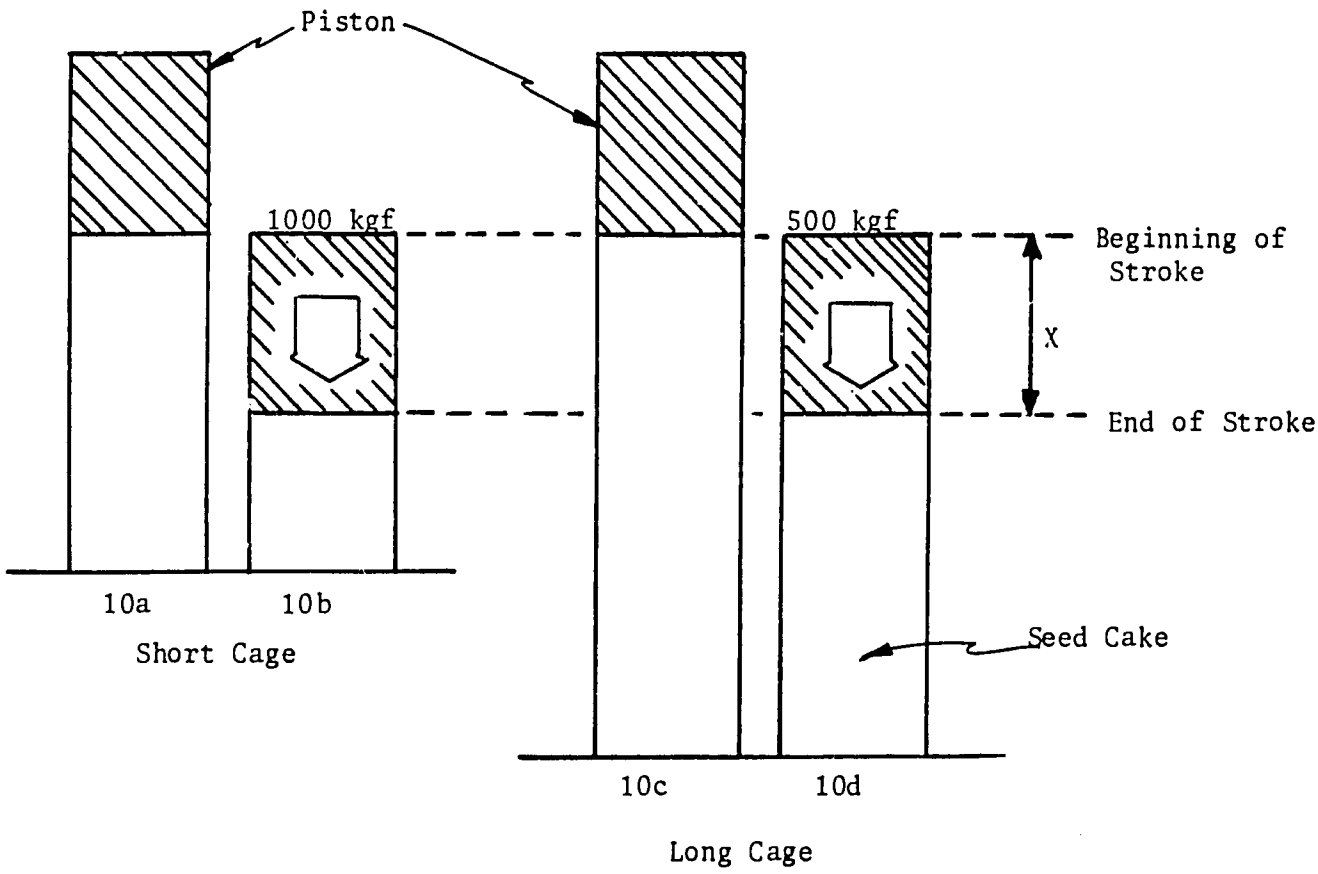
The taper, then, results in a more gradual build-up of force and the taper makes the material behave more like a sponge. As we saw in Figure 6, if we have a slower pressure build-up, we get to a higher peak pressure by the end of the stroke (before it becomes necessary to release the cone and allow the seed to discharge). Again, we do not want the pressure to build up too high at the beginning of the stroke, because it is only at the end of the stroke that the highest mechanical advantage can be utilized.

Because a higher peak pressure is reached using a tapered cage rather than a straight cage, I believe that a tapered cage generally expels more oil. A tapered cage has other advantages. As seed compresses and moves toward the rear of the cage, it spreads out causing the seed to shear and break up. A straight cage, by contrast, generates no shearing forces except along the wall.

Another possible variable to consider in designing the press is the shape of the restriction cone (ref. Figure 2). It is reasonable to assume that its shape would have some bearing on the physics of the oil pressing operation simply by virtue of the fact that the cone affects the back pressure and the release of compressed seed. The shape of the restriction cone is less likely to influence the value of the peak pressure than it is to determine the smoothness with which the seed cake comes out. The theory behind the curved cone, such as the one on Hugh Allen's (of CARE) press, is that at some point or another the seed material must flow out once the peak pressure point has been reached. If the material is discharged in a sudden jerk, you get a very sudden drop in pressure. The curved cone enables the seed material to flow out more smoothly, thereby permitting a more gradual and perhaps reduced drop in pressure. Thus even after the slippage, a high level of pressure will be maintained on the seed cake to assist the oil to flow outward. Another implication of this is that the entire pressing process may become less strenuous. If you can maintain a higher pressure after slippage, you may be able to increase press efficiency. All of this, however, still requires further study and testing in the field.

In addition to the shape of the cage, another important variable is its length. In Figure 10, we see two sets of cages, each set showing the piston at the beginning position and end position of a stroke. For each set, the distance traveled by the pistons is the same (distance X) from the start to the end of each stroke. In Figure 10a and 10b, however, the position of the piston indicates that the seed material within the cage is being compressed by at least 50 percent (the piston has traveled halfway through the cage). To get it to compress by that much (distance X) requires considerable force -- perhaps, let us say, 1000 kgf. Now, assuming that the long cage (10c, 10d) contains the same kind of material as in the short cage, you would need the same amount of force (1000 kgf) to achieve 50 percent compression. But in the

Figure 10
Short Cage vs. Long Cage



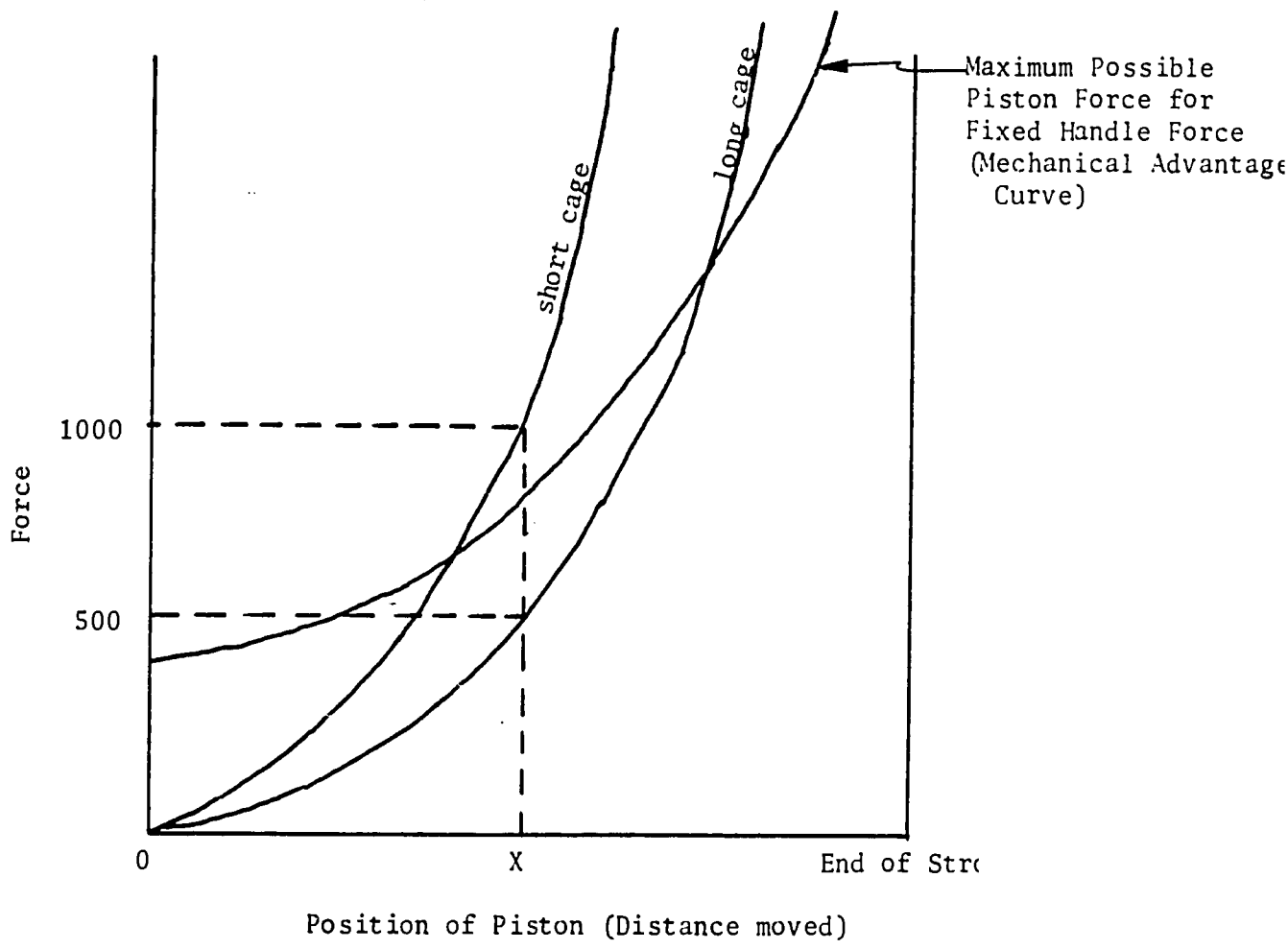
longer cage, the distance traveled by the piston (also distance X) represents a smaller percentage of the total length of the cage. It is not halfway down the length of the cage but perhaps only a third of the way -- and for this, perhaps only 500 kgf are needed. This means that in a longer cage, a given displacement of the piston requires less force and builds up less pressure than it does in a short cage.

All of this can be plotted on the graph contained in Figure 11. The mechanical advantage curve represents the maximum possible force that can be achieved at any given piston displacement for a fixed handle force. It is the line along which all peak pressures must fall. Now, let us first look at what is happening with the short cage. If it is compressed by 50 percent, we know it has taken 1000 kgf to do so. To depress the piston in a long cage by the same distance, however, requires perhaps only 500 kgf. This occurs because the piston's motion is fixed while the length of the cage varies. If we move the piston in the short cage by distance X, we have moved it 50 percent of the way down the length of the entire cage, which will require a very large handle force. In the longer cage, however, distance X represents a smaller percentage of the total cage length, and it will require less handle force.

By plotting all of this on a graph, we see that the pressure within the short cage builds up much more steeply and rapidly than it does in the long cage (Figure 11). Again, the peak pressures are located at the points where the maximum possible force curve intersects with either line. The important conclusion is that a long cage allows us to come to the end of the stroke before a high pressure is built up (ref. Figure 5) -- which means we have higher mechanical advantage. This means there will be a higher pressure in the cage for a given force on the end of the handle.

One might argue that the optimum press design would have a short cage and a short piston stroke, to keep the press operating in its area of maximum mechanical advantage (ref. figure 5) at the end of the stroke. However, a short stroke would only permit you to take in a very little amount of seed each time. This may indeed increase oil output per kg of seed, but there is also the economics of the press to consider, and the "throughput" (kilograms of seed per hour) would be greatly reduced. As it is, we are already taking in fairly small volumes of seed each time.

Figure 11
Force vs. Position of Piston for
Short and Long Cages



Summary

What have we learned in our discussion thus far? We know that to get more oil we need high peak pressure. And to generate high peak pressure, we need the following:

1. Small piston diameter. Because the pressure is the force divided by the area, a small cross-sectional area on the piston will give you higher pressure for the same force.

2. Long handle to achieve greater mechanical advantage.

3. Short pivot pin separation to increase mechanical advantage (ref. distance l in figure 4).

4. Tapered cage which, in addition to giving a higher peak pressure, also tends to break up the seed.

5. Relatively long cage which, apart from allowing us to get a higher peak pressure, also permits a given amount of seed to stay in the cage longer so more oil can leak out.

6. Smooth cage outlet.

Engineering Design: Strength and Costs

I now wish to discuss how the press can be made strong enough to hold up under regular use in the field. First, it is necessary to have a thorough understanding of how the machine itself operates. Then one must calculate the stresses and forces that every component of the machine will undergo. Finally, the components must be designed to withstand these estimated loads. These are standard engineering practices and are, essentially, what I have been doing for AT International. In designing and constructing the presses it is important to take conservative values for the strength of the mild steel because the mild steel available in most developing countries varies greatly. In order to design a machine that would be both light in weight and strong, we carried out a complete engineering analysis of every component of the press. We did not want to over-design it, nor did we want to under-design it.

There are, however, several crucial components of the ram press that must be especially strong. The cage is one of them. In fact, my own experiments indicate that it should be able to hold the pressure caused by 10 tons of load on the piston. To achieve this, there are formulae that can be used to calculate optimal thickness of cage bars, the spacing of the gaps between them, the distance between the cage rings, and the size of the rings themselves (ref. Figure 1).

The pivot pins must be able to withstand 10 tons of load, and also must be very strong to avoid bending. If they are too long, they will bend for the simple reason that under the same force long pins will bend more easily than short pins. So the shorter the pins or the narrower the machine, the stronger the press will be. Widening the machine does allow for easier access, but one must compensate by increasing the diameter of the pins. As a rule, the pins must be at least 60 mm in diameter if the distance between them is more than 150 mm.

The handle also must be very strong. To ensure that it is, one must calculate the magnitude of the load or "bending force" to which it will be subjected.

The side or "pulling" arms that move the piston must also be strong enough in tension to withstand a 10 ton force. But more importantly, they must be able to withstand the very high friction in the bushings. Bushings are the metal sleeves that separate the rotating pins from the fixed metal housing. They greatly reduce the frictional forces that would otherwise exist between the pin and the housing. Under 10 tons of load, it is difficult for the bushings to rotate. The result is that a very large "bending moment" or "bending force" is placed on the tie arms (Figure 1). The first press used half-inch round bars and every one of these bent in the field as a result of the friction. The friction can be reduced somewhat by using brass bushings and by providing lubrication holes, but you still need strong tie arms.

Another variable is wear on the piston. In this case, the culprit is not usually lubrication (as the area basically lubricates itself under normal operation), but poor fit between the piston and the cylinder. A poor fit allows small particles of foreign matter (some from the oil itself) to get in between the piston and the cylinder, which then causes excessive wear and friction. Some of the particles that enter the cylinder can be avoided by ensuring that the seed is clean and winnowed. But it also is necessary to have no more than what is known as a "sliding fit" between the sides of the piston and the cylinder walls -- one that allows space for only a thin layer of oil. Also, if the piston is not fully supported at the back end of the cylinder, it tends to tilt up in the outward position and rub against the cylinder walls, also causing wear. So you really need a good piston support.

There has been some discussion of whether it really is necessary to machine the compression cylinder. Obviously, not having to do so would be much simpler. One of the difficulties of machining the cylinder is that all welding must be done first. Welding after machining would cause distortions along the cylinder. One alternative (introduced by Hugh Allen) is to have a very thick walled cylinder, which permits some light welding afterward. In most cases, however -- especially if you are using pipe -- it means you have to do all your welding first. In Bielenberg's early press design, the cylinder was simply a piece of pipe that

had been machined inside and had a hole cut out of it for seed to fall into the cylinder. It was not welded to anything, but rather was held in place by bolts so that it could be removed and replaced easily. As far as the two models we saw this morning are concerned, Hugh and I feel -- and again, we may be proven wrong in the Allen field tests -- that with the extra support for the piston, we will get less wear on the cylinders and, therefore, not need to replace them.

The last component to be discussed is the restriction cone. Whatever effect the shape has on pressing efficiency, the fact remains that the cone itself is subject to a lot of force. This means that the threads holding it in place must be very strong. This is especially important because it is difficult to align the cone perfectly so as to ensure that all the forces are centered down the middle of the cone.

There has been some interest in whether certain parts of the press can be cast. The restriction cone, the cylinder, perhaps the piston, and even some of the main body parts, if designed slightly differently, could be cast. Yet cast iron can be somewhat brittle. It is not quite as strong as even mild steel. From the quality of casting I have seen in Kenya and Tanzania, I would not recommend it for any important component of the press.

Reducing Costs

I would like to say just a few words about possible ways to reduce costs once all the engineering analyses on the press have been carried out. To keep the cost of materials and cost of labor as low as possible, the best advice is to avoid overdesign. One must identify appropriate design criteria and then stick to them. Parts that are under heavy loads must be adequately strengthened, while those that are not should be handled simply.

One of the best ways to save money on machining costs is to use standard sized materials and to simplify designs so as to minimize the need for machining in the first place. This may mean, for example, using pipes instead of bushings.

Finally, costs can be reduced by simplifying manufacturing procedures, such as by using welding jigs and fixtures. This will enable a machine shop to begin mass production fairly quickly. Indeed, in the case of the ram press, it is actually quite difficult to build even a prototype without using a jig at least to assemble the tapered cage.

During the next few months ATI will be producing a manual for a standardized press design. Then anyone wishing to start up production can take the manual to a machine shop and have the jigs and fixtures produced. Without such specifications, different machine shops may improvise and change the design without

justification. The result, in all probability, would be that a large number of presses would break apart in the field.

SUNFLOWER SEED RESEARCH

John Mugeto, Egerton University

In March 1988, Egerton and the International Development Research Centre (IDRC) sponsored a project to survey oil processing in rural areas of Kenya. When we visited four provinces we found five screw expellers but only one of them was being used. No manually operated presses were found.

The various surveys revealed two problems. A major problem was lack of sufficient seed for pressing at the sites. We also observed that cake was being left behind. In some places where seed had been pressed two or three years before, the cake was still lying around and was rotting. The farmers were not aware that the cake could be used for animal feed.

We had learned about the ram press from others. In order to get first hand experience, three senior members of the project team traveled to Arusha. We wanted to get practical knowledge of the operations, problems, and maintenance requirements for the press. At a later date, one ram press was brought to Egerton University from Arusha in order to carry out laboratory tests.

Laboratory tests were carried out on two versions of the Bielenberg press, one version made by Martin Fisher (Action-Aid) and the other by Hugh Allen (CARE). The objectives of the tests were:

1. To understand the components and operational procedures of the ram press;

2. To obtain performance data -- throughput (kg/hr), extraction efficiency, oil yield, etc.;

3. To investigate operational problems and from the results of the tests and other observations develop ideas for improving the designs; and

4. To analyze the composition and quality of the oil and cake.

No pre-treatment operations were carried out. However, large chunks of chaff from the sunflower head were hand picked before pressing.

Two varieties of Kenyan open pollinating sunflower seed were tested -- fedha and shaba. These were obtained from the National Plant Breeding Station in Njoro. In addition one test was run to using seeds from Tanzania.

The data obtained during the initial tests with the two models of the ram press are presented in Tables I and II. Problems identified in the Fisher version (see Table I) of the Bielenberg press included:

1. The throughput value of 2.4 kg/hr was too low compared to the rated capacity of 7-14 kg/hr.

2. The machine was difficult to operate.

3. Oil only flowed from the one-third of the cage section nearest to the piston. Some oil flowed from the joint between the cylinder and cage. This occurred because the piston stroke fell short of the cage by about 2.5 cm.

The following changes were proposed:

1. The optimum setting of the restriction cone needed to be determined to reduce the effort and improve throughput while maintaining extraction efficiency.

2. The cylinder needed re-designing so that the piston stroke could cover about 2 cm of the cage.

These changes were made and Table III gives the results. The restriction cone was set so that 2-3 threads were left on the cone side. A cylinder shorter by 5 cm was fabricated at the Department of Agricultural Engineering. As shown in the tables, these changes doubled the throughput while oil yield and extraction efficiency increased slightly.

Other improvements have been made by Hugh Allen on his version of the Bielenberg press with even better results, as shown in Table IV.

1. The clearance between the slats was increased on the press resulting in reduced effort requirements, higher oil yields and fewer problems with clogging.

2. The piston diameter was reduced by 5 mm and adjusted so that the piston stroke reaches the seed cage.

A chemical analysis of oil and cake from both the ram press and the screw expeller was conducted at the University food technology and animal nutrition labs. These results are presented in Table V. Some observations on the results:

1. Color of oil

   - Oil from the ram press is a yellowish color.
   - Oil from the screw expeller is a brownish color.

TABLE I

DATA FROM TESTS WITH THE BIELENBIERG - FISHER* RAM PRESS

DATE 21ST OCTOBER 1988 TIME: MORNING

LOCATION: EGERTON UNIVERSITY

SEED: KENYA SHABA (OPEN POLLINATED)

PRETREATMENT OPERATIONS:

SEED MOISTURE CONTENT: ≅ 9%

OPERATION:

TESTS	MASS OF SEED KG	MASS OF OIL KG	TIME TAKEN MIN	'THRO'PUT KG/HR	OIL YIELD BY MASS %	EXTRACTION EFFICIENCY %
1	1.0	0.20	25	2.4	20	57.1
2	1.0	0.23	26	2.3	23	65.7
3	1.0	0.23	25	2.4	23	65.7
4	1.0	0.22	24	2.5	22	62.8
Average		0.22	25	2.4	22	62.8

* Machine bought from Tanzania

TABLE II

DATA FROM TESTS WITH THE BIELENBERG - ALLEN PRESS

DATE: NOVERMBER 1988

LOCATION: EGERTON UNIVERSITY

SEED VARIETY: KENYA SHABA (OPEN POLLINATED)

*SEED PRETREATMENT:

SEED M.C. (%) ≅ 9%

OPERATION:

TRIAL	MASS OF SEEDS (KG)	MASS OF OIL (KG)	TIME TAKEN (MIN)	MASS OF CAKE (KG)	THRO'PUT (KG/HR)	OIL YIELD BY MASS (%)	EXTRACTION EFFICIENCY
1	1.0	0.18	12	0.79	5.00	18	51
2	1.0	0.17	11.5	0.80	5.20	17	48.6
3	1.0	0.18	12	0.71	5.00	18	51
4	1.0	0.18	12	0.76	5.00	18	51
Average values	1.0	0.178	11.88	.765	5.00	17.8	50.4

* The ram press used was the Bielenberg-Hugh Allen Machine. This data was obtained before the improvement of the cage opening and changing the dimensions of the piston and cylinder. The diameters for old and new pistons are 49 mm and 44 mm respectively.

TABLE III

DATA FOR PRESS WITH SHORTER CYLINDER

BIELENBERG - FISHER PRESS

DATE: NOVEMBER 1988 TIME: MORNING

LOCATION: EGERTON UNIVERSITY

SEED VARIETY: KENYA SHABA (OPEN POLLINATED)

OPERATION:

TRIAL	MASS OF SEED (KG)	MASS OF OIL (KG)	TIME TAKEN (MIN)	MASS OF CAKE (KG)	THRO'PUT (KG/HR)	OIL YIELD BY MASS (%)	EXTRACTION EFFICIENCY (%)
1	1.0	0.22	12	0.77	5.0	22	62.8
2	1.0	0.24	12	0.74	5.0	24	68.8
3	1.0	0.23	12	0.75	5.0	23	65.7
4	1.0	0.22	11	0.76	5.45	22	62.8
Average value	1.0	0.228	11.75	0.76	5.10	22.75	65

TABLE IV

DATA OBTAINED WITH IMPROVED BIELENBERG - ALLEN PRESS

DATE: 13/2/89 TIME: MORNING

LOCATION: EGERTON UNIVERSITY PROCESSING LABORATORY

SEED: KENYA FEDHA MOISTURE CONTENT ≅ 9%

PRETREATMENT OPERATIONS:

OPERATION:

DETAILS TESTS	MASS OF SEED (KG)	MASS OF OIL (KG)	TIME TAKEN MIN.	MASS OF CAKE (KG)	THRO'PUT KG/HR	OIL YIELD BY MASS %	EXTRACTION EFFICIENCY %
1	2.0	0.40	11	1.60	9.1	20	57
2	2.0	0.42	13	1.58	9.23	21	60
3	2.0	0.39	12	1.61	10.00	19.5	56
4	2.0	0.38	14	1.62	8.57	19	54
5	2.0	0.38	14	1.62	8.57	19	54
6	2.0	0.39	13	1.61	9.23	19.5	56
Average values		0.393	12.83	1.60	9.42	19.67	56

TABLE V

DATA: CHEMICAL AND PHYSICAL TESTS ON SUNFLOWER AND SOYABEAN OIL AND CAKE

DATE: OCTOBER 1988

LOCATION: EGERTON UNIVERSITY - FOOD TECHNOLOGY AND ANIMAL NUTRITION LABORATORIES

PARAMETER / MATERIAL	Peroxide Test Mega/Kg	Protein %	Oil Content	Colour	Iodine value	Acid Value	F.FA[2] %	Moisture %	Ash %	Fibre %	N.F.E.[3] %
Sunflower seed	-	-	35	Black	-	-	-	8-9	-	-	-
Screw Expeller Sunflower oil	4.3	-	-	Brown	-	-	-	-	-	-	-
Ram Press Sunflower oil	8.8	-	-	Yellow	-	-	-	-	-	-	-
Screw expeller sunflower cake	-	35.5	3.33	-	-	-	-	-	6.4	-	-
Ram press sunflower cake	-	27.3	11.06	-	-	-	-	-	6.0	-	-
Screw expeller soybean oil	-	-	-	Dark brown	116	6.5	3.25	-	-	-	-
Screw expeller soybean cake	-	50.37	10.71	Brown	-	-	-	8.85	8.75	9.58	21.60

1. Mega equivalents
2. Free fatty acids
3. Nitrogen Free Extract

This difference in color was caused by a breakdown of the triglycerides due to excessive heat (120°F-140°F) during expeller operation.

2. Peroxide test

   The difference is also due to heat.

3. Residual Oil

   It is high in the ram press cake. It is recommended that cake for animal feed contain 5% or less oil. If the oil content is higher, the cake should be mixed with other ingredients.

4. Free fatty acid and acid values are a measure of decomposition which is accelerated by light and heat. FFA should be less than 1%.

At Egerton we want to look at the whole enterprise -- in this instance both the oil and the cake. One of our objectives was to study the composition of the cake and determine how it best can be used. We are convinced that if the cake is not utilized, then the oil extraction may not be profitable. Part of our future plans involve finding proper methods of processing the cake to avoid problems with aflatoxins.

Questions and Comments

Lynn Schlueter commenting on aflatoxins:

We have submitted some of our oil to the Kenya Bureau of Standards and the results came back showing zero aflatoxins. This issue of aflatoxins comes up often because it is a great concern to many people. On one occasion I saw some cake that had been left behind; water had gotten into it, and it was moldy and attracting insects and so forth. That looked like a situation for aflatoxins. It's the mold on the seed that produces aflatoxins and we just haven't seen much of it.

(**ATI Note:** Where aflatoxins exist, they probably are going to remain in the cake and not come out in the oil.)

Hugh Allen, commenting on press performance:

When I came to Egerton University, there were two modes of operating the press. We could operate it in a mode that we subjectively determined was the rate at which a person could sustain the work, which generally involved a five second rest at the end of each stroke. Using this mode, we were putting seed through at the rate of about 9.7 kilos an hour. Then we wondered about the situation that has occurred, I believe, in Tanzania in

which people come in and work as fast as they can for about half an hour or 45 minutes. So we organized ourselves to work in that way and we got a seed throughput of 21.17 kilos an hour. But this was at the expense of about 8 or 9% reduced extraction efficiency. I think it's a little misleading to suggest that these are the capacity figures for the press. These are figures that tend to pertain when you are operating in a style that holds the handle down for five seconds. But if you choose to have lots of labor you could theoretically achieve higher rates of throughput.

Carlos Zulberti on how to use cake for animal feed:

It depends on the livestock you are feeding and the type of feed you are combining the cake with. If you are feeding pigs there is not much of a problem, but if you are feeding poultry and more than 5% oil remains in the cake it would not be good. An oil content of up to 15% would probably be okay for cattle.

Dr. Carlos Zulberti, Egerton University/IDRC

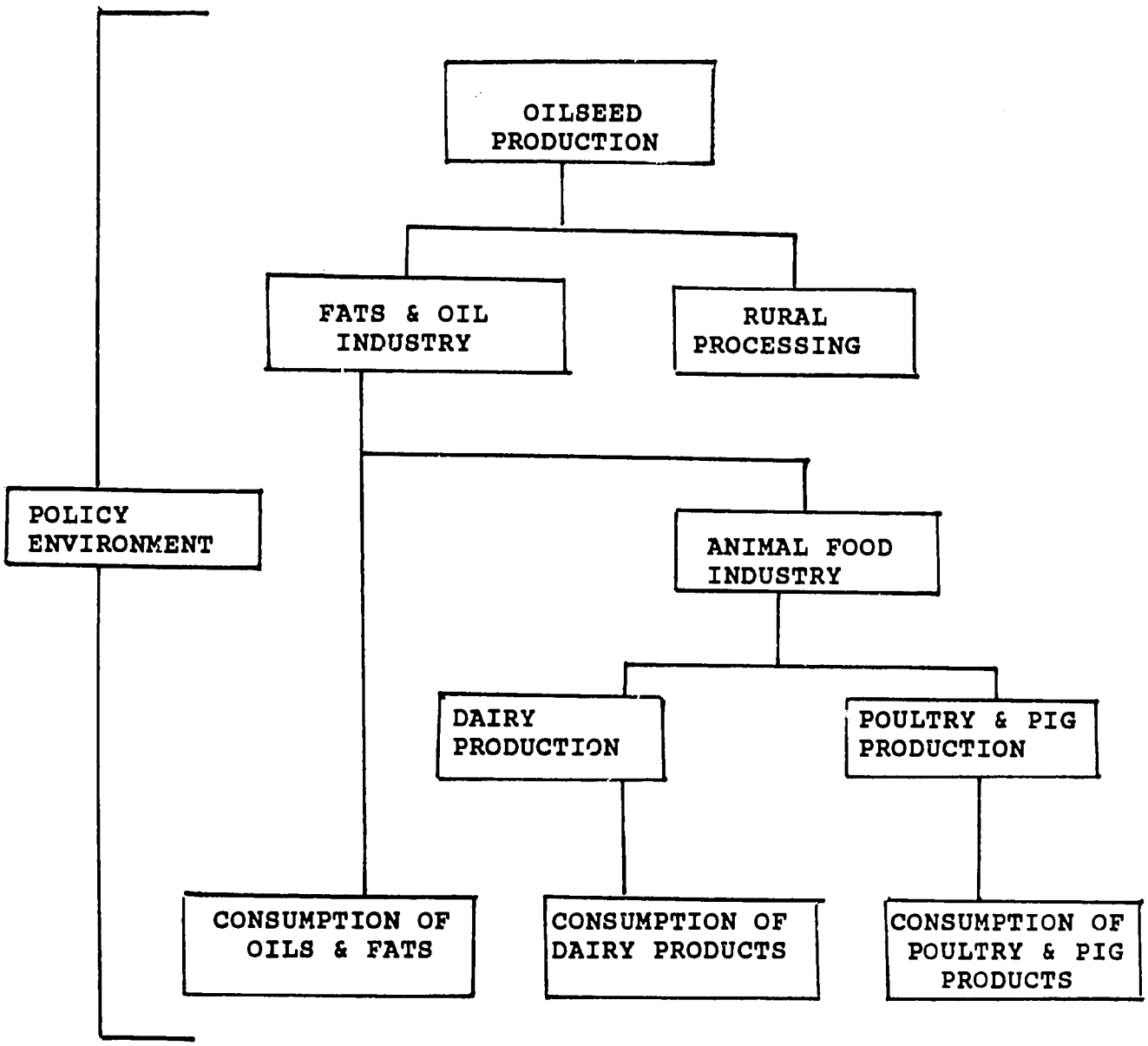
IDRC has financed an oilseed crop network that covers East Africa and South Asia. For about the last five to seven years, IDRC financed local research in the different countries in the region to improve oil seed crop cultivation. A big question arose three years ago concerning the need for this research because of the excess production worldwide.

In October 1987, IDRC decided to look at the oilseed situation in one specific country, Kenya (Figure 12). We came to the conclusion that while it was true that Kenya was importing relatively cheap oil from the international market, it amounted to between $60 million to $70 million annually! Seventy to eighty percent of the country's oil was being imported and full demand was not being met. Kenya has a population growth rate of more than 4% a year. How can Kenya afford to continue to import oil when the population is growing that rapidly?

There was an interesting article from the World Bank about two months ago which stated that oil is one of the highest variability commodities in the world. In other words, there are few commodities that change price as fast as copra oil or palm oil, for example. This means that you don't really know what you will have to pay for oil next year.

To gain a better understanding of the situation in Kenya, we decided to study, among other factors, oil seed production at the family level, at the industry level, and the animal food industry. One important fact that people forget is that if you import oil, you also must import cake or the animal industry will suffer. If you aren't producing oil locally, then you aren't producing cake either.

Figure 12
Vegetable Oil/Protein System in Kenya



What is the policy environment that affects demand in Kenya? Do we have duty, taxes, fixed prices? What is the system? What are the transportation limitations? These are all questions we looked at. As far as we know there is very little experience in Kenya with rural processing. We wanted to find out what the potential would be. We are now in the process of correcting the report that was first drafted in December.

We have found that the rural oil processing situation in Kenya may be very difficult to deal with. Why? Because of competition. Every Kenyan can go to the duka (store) next door and get a tin of Kimbo fat relatively cheaply. Rural producers will have to compete against these low prices. In Tanzania the situation is different.

What are the possibilities for competing against these cheap prices? The fat and oil industry in Kenya is concentrated mainly in Nakuru, Nairobi and Mombasa. Everything being produced has to go to downtown Nairobi and then be shipped to where it's needed; this includes the cake. Maybe the cake is what is going to make the difference. If you can have cake produced at the farm level, it may pay to produce the oil.

The consumption of oil in Kenya is roughly 5 kgs per person per year; we have a family size of about ten people, so we are talking about 50 kilograms per family per year. The machines we are talking about are going to produce much more than that. Therefore, if you cannot sell the surplus you are in trouble. The surplus will most likely be oil and not cake.

When looking at the situation here in Kenya we need to keep in mind the figures I told you before -- the $60-70 million of oil being imported. In Kenya there was a duty of 40% on imported oil but this has been changed. Now there is effectively no duty on imported oil. Nevertheless, the prices increased last year. In addition, when the government removed the duty, they removed it for both refined and crude oil. The mix of oil being imported changed from 80M crude and 1M refined to about 70M refined and 30M crude. The industry, instead of adding value locally, is buying the cheapest product available on the international market!

Kenya imports about $15 million a year of tallow to make soaps. As soon as the government removed the duty from imported palm oil, the importation of tallow was reduced from $15 million to $5 million annually, and the importation of oil increased. That means that palm oil competes with tallow in the local soap making industry.

Now that I've tried to give you some background about the whole industry, let's look at the rural processing area.

In Kenya, we have a subsidiary company that was established by East African Industries, the largest processor of oils and soaps in Kenya. East African Industries is owned by Unilever and the

Government of Kenya and is the largest importer of palm oil. When the price of palm oil was skyrocketing about five years ago, E.A. Industries created a local company called Oil Crop Development. It was quite successful in promoting the growing of sunflower for two to three years. But when international prices dropped, East African Industries was no longer interested in buying local seed because it was cheaper to import it. So they reduced the prices paid to the farmer for sunflower from 3.20 per kilo to 2.80 and farmers stopped producing. That means if you want to promote the local industry you need stable prices and not fluctuations based on the international market price.

What other knowledge do we need to be able to use the oilseed ram press in the field?

We need to generate data on seeds and work with plant breeders to let them know our needs. For example, sometimes you will have machines that cannot be modified and you will have to adapt the seed to the machine. Sometimes the situation will be reversed and you should adapt the machine to the seed.

What are some important aspects of this technology we need to keep in mind? In engineering there are two: processing (pre-treatment, filtering and storage) and manufacturing. With manufacturing there are issues of jigs and fixtures and quality control.

We also have to consider the two products -- liquid oil and the protein cake. In Kenya there is no tradition of cooking with liquid oil. How will the public react to this oil? We really don't know what their reaction will be. That's why we need to involve people in the area of home economics who develop recipes, etc.

We have already talked a bit about protein cake. Right now we really don't know how to mix this, how many kilograms of protein cake should be taken with how many kilograms of maize bran or grains, etc. Again, this is an area in which further research is needed.

Other questions involve marketing of surplus and ownership. Who will own these machines -- groups, co-ops, farmers? In Kenya we don't yet know how the public is going to react. So in addition to developing the "hardware" -- the press -- we need to develop the "software" to go along with it. In Kenya, when a demonstration project is set up using the press we also need to be able to answer questions such as, "What type of seed do I use? What is the spacing? What time of year do I plant? What do I do with the cake? To whom am I going to sell my excess oil?" All of these things need to be considered before we can really say that we are introducing the technology. It is the interaction of the "software" around the "hardware" that we need to consider.

I am not saying that you have to solve all of these problems before you go into the field -- if this were the case, you would

never get there. I am just saying that if you don't consider all of the possible problems then you won't know how to analyze what is happening. Figure 13 illustrates different aspects of the oilseed question. Probably all of you could come up with additional boxes to add to this diagram.

GENERAL DISCUSSION COMMENTS

Lynn Schlueter

In Arusha region, people keep a lot of cattle. About four or five months out of the year milk fat is available and among cattle keeping people (Masai) that is the preferred source of cooking fat. Other than that people probably go without and just buy small amounts of oil on special occasions. The receptivity to sunflower oil has been tremendous. People like the quality and are impressed with the fact that they can re-use it several times when frying. We haven't seen a problem yet with oversupply of oil -- it's all being used locally. It is replacing oil that has been brought in from outside. In fact, liquid oil has been well received. In Arusha town, people do prefer cooking fat; they like Kimbo and Cowboy but they buy sunflower oil when it's available. Liquid oil is not a new phenomenon in Tanzania, it just has not been widely available.

Axel Utermohlen

In Lushoto (Tanzania) imported oil is available in the markets but it is very expensive and people only buy very small quantities. Liquid oil is very popular. In these mountainous areas we have had no problem in selling the oil -- it is sold as soon as it comes out of the machine. One of our concerns is with availability of seed. The machines are working but there is just not enough seed.

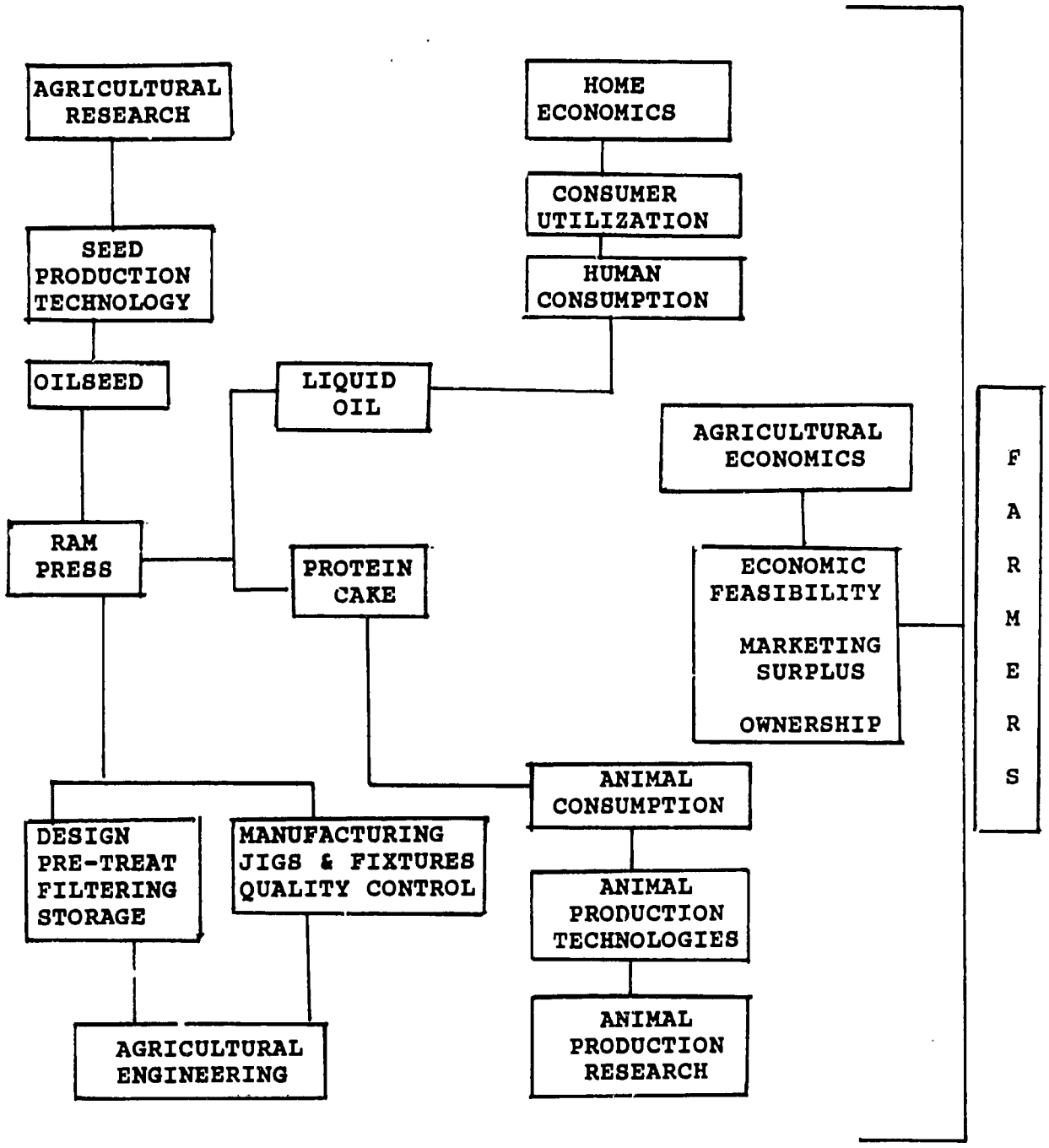
Martin Fisher

The limited reaction we have had in Kenya is that people sometimes don't even know what sunflower oil is. Some people recognize it as salad oil, and other people say it's good for chapatas.

Jordan Holtam

We found people in Zambia walking 35 kilometers to find cooking oil -- it just isn't available. In some places they were using peanut butter. One of the things we are doing is meeting with plant breeders and letting them know the kind of seed we need for this machine.

Figure 13
Introduction of Oilseed Ram Press Technology



Willie Salmond, Edison Rugumayo

When oil is available in Uganda it is very expensive. Money is available for manufacturing presses and we are in the process of choosing technologies. A prerequisite is that manufacturing has to be done locally. Our concerns are with quality control in manufacturing and with agricultural extension.

Mike O'Donnell

A very important question which has not yet been raised is how do we plan for regional coordination to promote this very appropriate technology. What can we as a group do to more effectively share this information? What should we be doing?

In the discussion that followed, the following suggestions were put forth:

- Publish and distribute a newsletter.
- Copy reports to all members of the network.
- Select a full-time coordinator for this network.
- Get involved in the survey PACT is undertaking.
- Hold a conference in another 12 to 18 months which will include the presentation of papers on research being done on the press and related topics.

CONCLUSION

Michael O'Donnell, ATI

I'd like to thank all of you for being here. As I said earlier today, we are very pleased with the large attendance. The presentations and the questions indicate that the ram press is one of the most successful technologies that ATI and LWR are promoting. As you know, work on finalizing the design of the press is continuing, as is research in other areas.

We intend to keep everyone here informed about all the work we are doing with the Bielenberg ram press. In about three months, you will receive a copy of the proceedings. Following that, we hope to print a newsletter or to send you updates on project activities. But information is a two way street. Please let us -- ATI and Lynn Schlueter of LWR -- know what you are doing in the field.

I hope to see all of you again at our second sunflower oilseed conference, probably within the next eighteen months. Thanks again for being here.

Proceedings compiled by AT International: Michael O'Donnell; Jamie Raile; John Skibiak; with contributions from Russ Read, Mechanical Engineer, Technical Resource Group; Elaine Feister; and Arleen Richman, Editor.