UPGRADING SEED QUALITY - A JOB FOR THE ENTIRE SEED INDUSTRY

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During this 16th Annual Short Course for Seedsmen, you will have the opportunity to gain valuable information in six extremely important areas that can and do function for the "Upgrading of Seed Quality". They are: THROUGH... planned programs... better processing... automation... better handling... improved tests... quality control. Each and every one of these areas should command your attention. I shall leave it to the several extremely well qualified persons on the program to explore with you what can be done NOW to improve seed quality.

As a director of the American Seed Research Foundation, I am more than pleased to note a number of speakers on your program who have carried on seed research projects for the foundation. I believe it will be of interest to you to learn of the scope of some of the research projects supported by the American Seed Research Foundation. This past year the following projects were brought to a close:

1. Seed Transmission of Plant Pathogenic Bacteria with Emphasis on the Factors Affecting Seed Contamination and Seedling Infection. Dr. R. G. Grogan, University of California, Davis.

2. A Seed Bibliography. Dr. Lela V. Barton, Boyce Thompson Institute for Plant Research, Yonkers, New York.

3. Affects of Physiological Seed Deterioration on Plant Growth and Development. Dr. D. F. Grabe, Iowa State University, Ames, Iowa.

4. Developments of Methods for Predicting Longevity (Life Expectancy) of Crop Seed Lots in Storage. Dr. James C. Delouche, Mississippi State University, State College, Mississippi.


1/ Mr. Arnold is the president of Arnold-Thomas Seed Company in Fresno, California.
6. The Role of Protein and Nucleic Acid Synthesis During Seed Germination. Dr. J. H. Cherry and Dr. F. O. Lanphear, Purdue University, Lafayette, Indiana.

This year the foundation will initiate the following projects:


2. Investigation of Effect of Temperature During Imbibition on Germination and Seedling Growth. Charles W. Basham, Colorado State University, Fort Collins, Colorado.

3. Physiological Basis of Seed Longevity. Dr. D. R. Grabe, Iowa State University, Ames, Iowa.

4. Separation of Seeds on Basis of Viability and Vigor. Dr. James C. Delouche, Mississippi State University, State College, Mississippi.


Many of these projects are quite basic in the nature of research on seed but directly or indirectly they are bound to have an influence on seed quality.

In this all important matter ... "Upgrading Seed Quality" ... possibly we should ask ourselves, "Where do we go from here?"

As an industry, over the last 15 to 20 years, we have made great strides in upgrading seed quality ... thanks to such conferences as this one and others held in several other states. However, there is still a lot of "unfinished business" in this area of "Upgrading Seed Quality". This applies not only to the seed trade who handle the physical movement of the seed from the producer to the consuming farmer but as well to the man who grows the seed, the plant breeders, the extension agronomists, the certification agencies, the seed technologists in our seed laboratories, the industry who manufactures seed cleaning equipment, the container industry, the herbicide, insecticide and fungicide industries, the legume seed preinoculation industry, the fertilizer industry, the farm equipment industry, the cotton ginning industry, the state and federal seed control personnel, the research personnel in Seed Technology Laboratories such as the one here at Mississippi State University and I am sure there are others that should have a part in "Upgrading Seed Quality" which could be added to this list.
So, where do we start to discuss this "unfinished business". To be real honest with you, I am not sure where to start ... but, as we all know, the train will never move unless we open up the throttle slowly at first to take up the slack and then use a heavy hand or foot, whichever may be the case, to bring the moving cargo to the desired speed to match the time schedule to keep out of the way of following trains or to be at a designated point to permit passage of trains moving in the opposite direction, but I am sure that there are trains following me, and with important messages. So, I must move ahead and get the train moving.

Weeds as we will see do represent a serious loss to agriculture in the production of food, feed and fiber. Weeds are plants growing where they are not wanted and are a nuisance for one reason or another. At times, even plants of some of our major agricultural crops can be classed as weeds.

Weeds reduce the quality and quantity of crop and livestock production; increase the cost of labor, equipment and water for irrigation; they may harbor insects, nematodes and disease organisms; clog irrigation and drainage canals and ditches; impair the health of livestock and humans; and cause heavy outlay in funds to control them or keep them in check along highways, railroad right-of-ways, parks, lawns, golf courses and in forests.

Growing weeds represent a heavy drain on available soil moisture. By comparison, the corn plant requires 368 pounds of water to produce a pound of corn (dry-matter basis), whereas lambsquarter and ragweed use 800 and 950 pounds respectively.

The time will come when this nation cannot afford the luxury of weeds on our agricultural crop lands. We, in the seed industry, must do our utmost to help alleviate the losses due to weeds and the drain they exert on our precious supply of water. We sometimes hear - "Water, Water, Everywhere ---!"] You know how to finish the phrase. But let's consider some of the facts about this "raw product" in our agricultural enterprise. It has been said, 97.2% of the world's water contains salt and 2.1% is frozen - this leaves only .7% in rivers, lakes and underground geological formations to supply the water for wells, springs, etc. The United States consumes about 355 billion gallons of water daily and the use will increase to about 600 billion gallons by 1980. Thus, I repeat, the seed industry must help alleviate the loss of water in this nation which is consumed by weeds in our agricultural crops.

It has been reported that the average annual loss due to weeds in some of our major crops expressed in a percent of the crop value is:
Those engaged in handling and processing the multitude of seed crops, I am sure, view with concern the continued presence of weed seeds in our seed crops. Weed seeds represent one of the real problems in cleaning many of the field seed crops and some vegetable seed crops harvested in the United States. It has been estimated that weeds cause an annual loss to field crops of $1,543,415,000; forage seed crops $29,609,000; vegetable $122,249,000 and the total loss due to weeds for these crops plus pasture and rangelands and fruits and nuts is $2,459,630,000. The cost to try and control weeds in these crops is estimated to be $2,551,050,000. This adds up to a staggering charge against agriculture of over $5,000,000,000.

The seed crops showing heavy dollar losses were alfalfa 9.5 million, red clover 6.2 million, lespedeza 2.9 million and grasses (miscellaneous) 2 million. Data is not available for other seed crops such as vegetables, cereals, corn, etc., but in certain instances I am sure loss due to weeds can be substantial.

This conference has, throughout its existence, devoted many hours to the problem of removing weed seed from crop seeds produced by farmers. While we have made considerable progress in this matter of separating weed seed from crop seeds, it sure looks like someone in the seed industry still has a job to do.

It seems to me that the grower, the first link in the seed industry "chain", should be encouraged, persuaded, cajoled or required to produce seed containing fewer weed seed. Today, he has a great deal more going for him to get this job done - just look at all the herbicides - and I am sure more are on the way. Agronomists, extension service personnel, seed company representatives and the manufacturers of herbicides should work with and appraise the seed grower of the value of controlling weeds.

We must be ready and willing to put our shoulder to the wheel in this process of upgrading seed quality. If we neglect doing our fair share we may find ourselves "has beens". As they say, "Time and Tide wait for no man". In our case, I think we could paraphrase this by saying, Change waits for no one.

Change is all about us. Recently I saw some statistics that reported there were an estimated 3,629,000 babies born in the United
States last year, the lowest number of births since 1950. But the excess of births over deaths added about 1,760,000 million additional individuals to our total population which must be clothed and fed. And, as we all know, this is happening all over the world—and in some places with much greater acceleration. There must be a change if we, as a seed industry, are to have the needed quality seed to keep up with the impact of the population explosion at home and around the world—it is a compelling, demanding and frightening situation.

We, in business, are accustomed to change and I am sure the seed industry is no exception. Change brings with it the possibility of new opportunities. However, we must recognize the danger of just talking about change and yet actually doing very little to prepare for it. There is a real danger of self-deception in believing that we can meet future change by doing more of what we are doing now. We should and must not let ourselves be trapped into a false sense of security.

What can we as a seed industry do to adjust our mental ability toward constant innovation to keep abreast with change? We should:

1. Make a real effort to force change in our habit patterns in order not to become too deeply committed to them to such an extent as to limit our ability to accept new ideas rapidly.

2. Make it a point to master new skills that are part and parcel of change.

3. Adopt an inquiring attitude about whatever phase of the seed industry in which one is engaged.

4. Have an appreciation for and an understanding of the need for team-work.

Possibly, we should ask ourselves:

Why do I operate the way I do?
How much of what I am doing is based on sound principles, how much on opinion?
Are the demands of the seed industry upon me the same today as yesterday?

I am sure that the answers each of you might give to these questions would vary in some degree—but I would hope there would be a reasonable area of agreement. There should be, if we are to keep up with changes—the changes which will be demanded of our industry to further upgrade seed quality, to make the right kinds, varieties and quality of seed available to satisfy a hungry world.
If I thought for a minute that the answers to these questions would be vague, uncertain, at great variance; man, man, we sure got a lot of home work to do. Or maybe we should say in the vernacular of the good old days - boy, I guess we had better go to the wood shed.

Change - my, my, our farm programs sure do bring about change - they are a bit like a yo-yo, you don't know whether you are UP or DOWN. But we in the seed industry do know they do bring about change. At times I think we could safely say "confused change".

The great emphasis on expanded production of grain and oil crops has placed a heavy demand upon our industry to make available seed of these crops. And I dare say, there is a real need for long range planning which could upgrade seed quality in this segment of our industry.

Change. The 1964 census of Agriculture reported only 3,157,864 farms - a decrease of 552,639 from the number reported in 1959 - a 15% decrease. The average size farm in 1964 was 351.5 acres compared to 302.8 acres in 1959 - up 48.7 acres. This change to larger farm units does and will continue to create an interesting challenge to the seed industry as to how best to serve these farmers whose needs will become more demanding as to quality of the seeds they use to make their farming operations productive and profitable.

A comprehensive in-depth study was made by Michigan State University of their agriculture, entitled "Project '80 Rural Michigan Now and in 1980".

I wish to refer specifically to their Research Reports 44 and 47. It is rather interesting to note the guide posts which were established as a basis for evaluating Michigan agriculture by the year 1980.

"Between now and 1980 we assume:

1. No major war.
2. No major depression.
3. Inflation of about 1.5 percent per year in consumer prices.
4. Average weather and little success in controlling weather.
5. Development of new technology will be even more rapid than in the past 15 years.
6. The rate of adoption of new technology will be somewhat faster than in the past 15 years.

7. The continuation of some type of price support program with increasing emphasis on area development.

I believe the study in Michigan is fairly indicative of what is happening throughout the nation and here is what they have to say about the size of farms in Research Report 47:

"From the standpoint of the total acreage in farms, in 1964 about 41 percent was in farms of less than 180 acres and 59 percent in those above that acreage. By 1980, it is projected that the percentages will be 18 and 82 respectively. A look at the farms of 260 acres and larger may be of interest. In 1964 they made up 14 percent of all farms and contained about 40 percent of the total land in farms. It is projected that by 1980 farms of this size will constitute 35 percent of all the farms and that two-thirds of all farm land will be in such farms. They would average about 420 acres in size."

From this same study in Research Report 44, it is projected that there will be a marked reduction in the number of elevators and farm supply firms serving the farmers in Michigan by 1980. In 1965, there were approximately 650 local grain, feed and farm supply firms - by 1980 it is reasonable to expect there will be only 400 of these firms remaining. This represents about a 3 percent loss in number per year.

Some of the changes that will take place in the producing farm units, with a direct bearing on number of farm supply firms needed and of interest for this discussion, as contained in the Michigan report are:

1. "More scientific methods of production will be employed by all segments of farming. This means purchased input requirements will be specified within close tolerance and the complexities of such things as herbicides, pesticides, and fertilizers will require special new treatment, storage, and handling techniques."

2. "There will be more specialization in production - both by area and by individual farms. This will challenge the local elevator and farm supply agency to offer specialized services and the manager must be a competent counselor for these specialized activities."

3. "Production units will become more sophisticated in their record keeping - with more attention to output-input relation-
ships. This means that as more farm producers begin to examine their activities in terms of what happens over the production time period by complete cycles, market agencies in turn will be challenged to offer their services in terms of package or programs. . . . the market agency with diversified enterprises such as grain, bean and farm supply firms in Michigan will be challenged to adopt more appropriate record keeping systems and analytical techniques than are in common use today."

Yes - we are caught up in a dynamic and ever-changing agriculture - one which will challenge the ingenuity and tax the resourcefulness of those, particularly the seed industry, charged with servicing this segment of our national economy.

In any society, seed is the Foundation for Greatness. This is true whether we are considering wheat, corn, rice, cotton, soybeans, grasses, small seeded legumes or, for that fact, most any crop which contributes to man's sustenance or pleasure. Just look at reported acre yields - corn over two hundred bushels, wheat one-hundred-fifty bushels plus, alfalfa nine tons plus. And, I am sure, other fantastic yield patterns could be cited for many other commercial crops in the United States. Suffice it to say, this would not have happened unless there was available, quality seed of the proper varieties for our farmers to accomplish such feats of production. Just think, U.S. farmers last year spent $599 million for improved seed.

There is a dismal side to this picture which I am afraid does not contribute to such production performances. I now refer to the quality of some of the seed which our industry makes available to the consumer. This is seed improperly labeled as to mechanical purity, germination and freedom from troublesome weed seeds - seed improperly cleaned - seed improperly blended to give a uniform consistency.

The Seed Analysis Report - 1966 by the Pennsylvania Department of Agriculture showed that from July 1, 1965 to June 30, 1966, "Stop Sale" was placed on 401 lots of seed at 81 seed vendors for various reasons. The report covered a total of 4,528 samples taken - 1,095 for purity, 2,014 for noxious weed examination and 5,244 for germination. Inspectors in Pennsylvania collected 1,088 samples of agricultural seed for examination and testing and 11.6% were considered illegal for sale; likewise, of the 224 samples of mixtures of agricultural seed collected, 51.1% were illegal; and 2.9% of the 931 samples of vegetable seeds collected were illegal.

Part of the industry's problem is the type of job some seed growers do in producing a seed crop. A good example of this is the
quality of home-grown red clover seed reported by Pennsylvania. A total of 42 samples of red clover were tested or examined and 61.9% were considered illegal for sale. Twenty-six of these samples contained an average of 3,564 noxious weeds per pound, with one showing 40,500 per pound and the lowest had 468 per pound.

In this publication were two tests reported on apparently the same lot of Orchardgrass. At least the lot number reported was the same. One lot was labeled - purity 96.39 and inert 2.97, but when tested purity was found to be 90.07 and inert 9.34. The other lot was labeled - purity 96.39, inert 1.97 and other crop .64, while test results showed purity 92.07, inert 6.13 and other crop 1.80.

I should also like to relate some encouraging information from Indiana in their Inspection Report 58. They reported a steady decline in misbranded seed in a forty-year period. In 1925, 36.4 percent of samples (745) examined were seriously misbranded; by 1939 the figure was 15.8%; in 1940 only 9.9% were misbranded and in 1965 misbranding dropped to a low point of 2.8% of the 2,104 samples examined.

This same report gave a summary on the analysis of 280 lots of tagged and 23 lots of untagged red clover seed. The tagged lots showed a purity of 99.3 percent in contrast to untagged of 96.82 percent; inert .16 percent as compared to 1.0 percent and weeds .08 percent as compared to 1.63 percent. The number of weed seeds per pound on the tagged seed was 379 versus untagged at 7,331 per pound.

Yes --- "Where do we go from here?"

You can see there is plenty yet to be done to "Upgrade Seed Quality". So - where do we start? It is somewhat self-evident from the information on tagged and untagged red clover in Indiana and the results reported from Pennsylvania on red clover that a likely place to start in upgrading seed quality is with the grower. You cannot made a silk purse out of a sow's ear - so be it with seed. Improperly produced seed which contains noxious weeds, crop mixtures, immature seed, frost damaged seed, rain damaged seed, mechanical harvester damage, etc. - once produced under present-day philosophy finds its way into seed trade channels and finally ends up on some farm. How bad or how good such seed may be when it finds its way back to the farm depends in large part on:

1. How poor a quality one is willing to sell or, shall we say, peddle.

2. How successful and efficient one is in upgrading the quality through processing.
3. How much upgrading in quality can be brought about by blending with seed of extremely high quality.

The degree to which an individual firm would use any one or all three of these possibilities will be determined by management in light of market demand, processing facilities to cope with the problem, skilled machine technicians and proper blending facilities.

In regard to the latter, during the meeting of the Grain and Forage Crops Research Advisory Committee to the USDA, we were appraised by Mr. Leo Holman, ARS, of the research on blending seed being conducted here at Mississippi State University. In your Seed Technology Laboratory research is under way to try to come up with an improved seed blender. I understand there are at least four different configurations under test. I hope we may have the opportunity to see the progress being made in this very important area of uniformity of seed when packaged. Also, it is of interest to note this research project is partially financed by the Field Seed Insititute of North America.

As I view the program for this conference, one should be able to gather information to help with what to do with problem crops of seed that the grower "just lets happen" and where it may happen to a seed crop due to no fault of the grower.

Now let's dig a bit deeper into - "Where do we go from here?"

The seed trade has a substantial export market for U.S. grown seed. This past year seed exports reached a total of 128.2 million pounds valued at $33.1 million. Of this total, over half is made up of grass and legume seeds. The export of these seeds reached an all-time record - 68.3 million pounds valued at $18.7 million.

Just as a point of interest - aside from the seed, this nation exports the product of one out of every four crop producing acres. To give you some idea as to this volume, it would take 1.5 plus million freight cars to haul these export commodities. It has been reported this would be equivalent to three solid freight trains stretching from San Francisco to New York.

The importing countries are becoming more demanding both as to variety and quality. I believe many of these countries are moving away from price as the determining factor on where they buy and from whom they buy. There is a growing desire on the part of many countries to request the seed that they buy be certified. In fact, some countries will shortly insist that certain seeds all be certified. This trend may be an advantage to some of our industry and a distinct disadvantage to other
segments of our industry. In total, it does mean, however, that growers, extension people and the seed trade must work together to hold and expand the demand for U.S. grown seeds around the world.

The plant breeders, both public and private, have a real job in "Upgrading Seed Quality". Their role, to be sure, will be one of developing new and superior varieties which sound and must have real and economic merit both for the seed producer, the seed merchandizer and the consuming farmer.

The swing to single-cross corn hybrids certainly is not without its problems. Here is a case where the consuming farmer wants this kind of hybrid. The seed corn industry is therefore faced with a sizeable program realigning their entire hybrid corn production program to produce and process in quantity single-cross hybrids for this nation's corn growers.

Our plant breeders and plant scientists are hard at work to hybridize wheat, barley, alfalfa, many vegetables and flowers. Then too, the push to incorporate opaque-2 and floury-2 into corn and to increase the protein content, chlorophyll, xanthophyll, etc., of alfalfa.

Many of our seed crops must be cross-pollinators by insects to assure seed set. There are a number of wild pollinators such as the alkali and leaf-cutter bees, but probably the honey bee is our most versatile and widely used pollinator. Recent research has proven that the honey bee can be selected with preference for certain pollen. The USDA work at Utah has indicated that after three generations of selection, the preference for alfalfa pollen ranges from the high line of about 66 percent to the low line of about 8 percent.

On the strength of this information and other findings, nine seed companies organized Hy-Queen Research, Inc. in March, 1966. This is a non-profit corporation which has contracted with Dadant and Sons, Hamilton, Illinois, to carry on a honey bee breeding program to develop a more effective pollinating honey bee. This is a long-range program. It is projected that in about six years hybrid queen bees with the desired traits will be available and ready for queening colonies for use in pollination of alfalfa seed fields. This research is financed jointly by the two organizations and the anticipated cost of the program will be in the neighborhood of $200,000.

Now, you may ask, what does this have to do with upgrading seed quality of alfalfa seed. Just this, in addition to selection for alfalfa pollen preference there is every indication selection can also be towards a bee that will be active and an effective pollinator in the temperature range of 75° to 85°. In California and the Southwest, by proper management and cultural practices, alfalfa seed crops can be brought into bloom in early to mid-May. Thus, with an effective pollinator at this time of
year, it would be possible to harvest the seed crop in July rather than August and September. Aside from assured quality seed production, there should be a savings in weed and harmful insect control and decided savings on cost for irrigation water.

Then in June 1966, the USDA awarded a contract on bee research to the University of Illinois on the role that queen bee secretions play in work activities of bees within and outside of their colonies. The aim of this, and other basic research studies on honey bees, is to develop methods for complete control in bee management. Eventually, scientists hope to substitute chemicals, sound and controlled environment for the conventional bee hive, so that large numbers of honey bees can be used for specific purposes. Maybe someday, we will have a sting-less honey bee - stranger things have happened. Yes - looks like change is on the way for the honey bee.

These men of science are bound to bring about further change in our industry for the betterment of mankind - and for this, we all should be mighty thankful. For by the fruits of their labor, we may be able to hold the line against the staggering pyramiding of world population.

Let's pause for a moment and reflect on this phenomena, if you permit me to use that term. In my home state of California, a prediction was made by Hugo Fisher, California Resources Agency administrator before the Commonwealth Club in San Francisco last July that California will have 1.5 billion residents by the year 2066, if its population continues to expand unchecked.

Various projections as to world population by a given date are too numerous to mention; however, it seems like the year 2000 is a focal point to which long-range projections are directed. Right now the present world population is nearing 3.5 billion and by 2000 will exceed six billion, provided enough food can be produced. The population of the world, as we all know, is very unevenly distributed. By 1975 we can expect an additional 700 million people - that is, more than the population of India and, in fact, more than the entire population of the western hemisphere right now. By the year 2000, if present trends continue, two-thirds of the world population will be in the area from Turkey eastward to include China, India and the islands north of Australia.

These are startling figures if we but pause for a few moments to assess the impact on food production for the 700 million more people that will be populating the face of the earth in 1975. As indicated, this is more than the present population of India or that of the western hemisphere. To cope with the food needs of these 700 million people, it will
require an increase in world food production of 22 percent above levels in 1965. This will not be an easy task for it calls for increased production at a faster rate from 1965 to 1975 than took place from 1958 to 1965.

In addition to increased population, we are confronted with changes in our eating habits. For some time, domestically, there has been a decline in per capita consumption of potatoes, wheat, butter, fluid and condensed milk and eggs. Per capita use of food fats and oils and combined use of fruits and vegetables have remained relatively steady. The per capita consumption of beef and veal is expected to expand further, and by 1980 will be around 117 pounds. This compares with a per capita use of 105 pounds in 1964. Thus, anticipated domestic demand for beef by 1980 ranges some 40-50 percent above the high 1964 production rate, which was near the top of the production cycle. On the other hand, the use of pork per capita will decline moderately from 65 pounds in 1964 to less than 60 pounds by 1980. However, by 1980 the domestic market for hogs is projected for an increase of 16 percent when compared with 1964. While there has been indicated a decline in per capita use of milk products, there will still be needed around one-fifth larger production in 1980 than in 1964.

What does this have to do with the seed industry and particularly this conference?

Just this ------

From where I stand you and that vast array of companies and individuals in many walks of life associated in one way or another with our industry have a major role in seeing that mankind is fed and properly clothed. The more mouths there are to feed and bodies to clothe (excluding the mini-skirt) along with changes which may occur in eating habits are bound to have an influence on crop production patterns around the world. To be an effective seed industry, there is need to be cognizant of these trends and to direct ones skill toward making available quality seed of the kinds needed by the men who till the soil to attain a balanced production of crops in demand for feed, food and fiber.

So, "Where do we go from here?" in this process of "Upgrading Seed Quality".

1. There must be more care by growers to produce seed basically pure and free of harvest injury.

2. There must be more care in handling harvested seed to attain maximum purity, freedom from weeds and vigorous germination.
3. There must be more informational help from extension personnel to assist growers in combatting seed production problems.

4. There must be continued research by Seed Technology laboratories and machinery manufacturers to improve and upgrade processing equipment.

5. Plant breeders and scientists must constantly seek for new and superior varieties and develop new production techniques which will be helpful in maintaining a reasonable seed cost.

6. Associated industries must constantly search for methods of improving their services or products to aid the seed industry to "Upgrade Seed Quality".

Conferences such as this can be very productive if we keep in mind certain guidelines, such as:

1. This meeting belongs to you, otherwise you would not be here.

2. Success of this meeting in some degree rests with you.

3. Enter into the discussions enthusiastically.

4. Share freely of your experience.

5. Confine discussion to the problem under consideration.


7. Listen alertly to the discussion.

8. Appreciate the other fellow's point of view.

9. Avoid monopolizing the discussion.

10. Be prompt and regular in attendance.

And in closing, I would like to draw in part from comments I made in an address before the American Society of Agronomy in Stillwater, Oklahoma on August 23, 1966.

As I view the role of the seed industry in the years ahead, it is full of excitement. The demands upon your time, skills and innate ability
will be taxed to the limit by contingencies facing agri-business as it grids itself to feed and clothe the 700 million additional people who will populate this world by 1975.

"Upon your shoulders may rest the well-being of mankind. World population by 1975 will require 22 percent more food than is being produced now. The stakes are high - failure could lead to mass starvation in many parts of the world, or indirectly lead to World War III, a thermonuclear holocaust."

I ask you - is there any question as to where we must go from here?