

2012 THE "BORLAUG DIALOGUE"

October 19, 2012 - 12:30 p.m.

Daniel Hillel

Introduction by:

Ambassador Kenneth M. Quinn

President - World Food Prize Foundation

So welcome to our Laureate Luncheon. I know many of you think this is the culminating event of the World Food Prize, but it's not. We have a whole day tomorrow of our Global Youth Institute, and you know we have our 150 high school students, and there are 130, 140 teachers who are here. I introduced them yesterday, but this morning they were here, and then they were off on an event that our youth staff puts together for them. And this morning they packaged 24,000 meals which will go to feed hungry people. So let's have a hand for them.

We are here to honor our laureate again. He was terrific tonight, but as we do that, I want to be sure we recognize people here at the head table and part of this. And John and Janis Ruan, again, thanks to you. Yeah, they've seen you. But you haven't seen Al Clausi. Al, can you stand up so everybody could see you? Al flew in from Australia, so now let me explain to you who Al is. I know when you see him he looks a little bit younger than me, but Al is one of the original founders of the World Food Prize.

He was the very first and was founded as General Foods World Food Prize in 1986. And when there was a corporate reshuffling and the World Food Prize was about to disappear, Al came to Des Moines and had Norman Borlaug with him, and they were introduced to John Ruan Senior, and they were in the grand bargain that brought the World Food Prize. So none of this would be happening except for the Ruan support but for Al Clausi's leadership. So let's give Al a hand.

We have members of our Council of Advisors here, Sir Gordon Conway, Margaret Catley-Carlson, Ronnie Coffman is here someplace - I hope he's still here, to guide us. Minister Florence Chenoweth is here and His Excellency Sheikh Hamad Al-Thani... ___ Al-Thani (excuse me, Your Excellency), and I'm running on fumes now.

I also want to say a special word of thanks to FMC, to Linda Fralek for being with us. All week long I've been looking on the other side of my hotel room key card with beautiful World Food Prize on it and FMC - this is thanks to you and this luncheon - thanks to FMC. So let's thank them.

And of course I want to thank all of our other sponsors for our annual event, for our sponsors of the Hall of Laureates again.

Also want to say appreciation to my staff, our volunteers who are here. Let me say, you know, I tell people we're a small nonprofit with only about nine members on the staff. I try to keep the number a little vague with John over here so he doesn't think I'm making it too big. But this couldn't be done with nine people. We have wonderful interns who work in our office. We have volunteers. We have people who worked with us before who interned with us before, take off from their jobs to fly back here. They work. They're all indispensable. So if you all could stand up over here, and please, please join me in thanking all of them for what they did to make all of this possible.

Where's Ed. Let's ask the question. We also have beautiful music. Our harpist, Mary Foss, over there. So Mary stopped playing. Mary, can you come here. I've got something I need to discuss with you. She was playing on the grand staircase last night that brought the Secretary-General up. It was this magic moment. Here's the music, the art, the ceremony - all of this is happening. And, you know, we've had her doing this now for 12, 11, 12 years, a long time. She was in high school I think when we had her the first time. Come here. I like to tell people that we're kind of formal - Sir Gordon Conway, you know, we try to be a little pomp and circumstance, yeah. And so she has an appointment as the harpist to the World Food Prize. And so you've been with us a long time, and I have something to recognize you. And this is our World Food Prize Distinguished Service Award in recognize of your exceptional service and contribution as (here it is) the official harpist of the World Food Prize Foundation, signed by John and me.

[Mary Foss - I'm honored, I'm honored. Thank you.]

Okay, now go back and play.

So I know some of you are going on the farm tours this afternoon, so enjoy your lunch. We'll be back up later for the presentation of the diploma, and, if we have it, the World Food Prize funds to Dr. Hillel, and he will give his laureate lecture. So enjoy lunch.

So we can't start without the laureate, who's disappeared. I was going to make a bad joke and I won't - something about irrigation. I already made one bad joke this week about that, where our ideas come from. But I hope everybody enjoyed their lunch, the Israeli food. Let's thank the Marriott.

So I remember from college days, Dr. ____, when we showed up and the professor wasn't there, that if it was a full professor we gave him or her ten minutes. I don't know what the tradition is in Israel - maybe the students wouldn't dare leave, but, you know, in America it's different here. And so I think Daniel, I mean, he's more than a full professor.

Oh, that's a good idea. Wouldn't that be a great scene? Yeah, me up here. Well, you heard this morning what Ambassador Cousin said was that she was empowering women. They got the money, then the husband had to listen to her. Yeah, yeah. My wife, Le Son, said, "What's new about that?" He's had to listen to me for 38 years. It's true. Okay, we'll wait for Dr. Hillel to come back. Oh, here he comes, dramatic, entering the room. All right, so we can continue.

First I have an announcement. The Iowa Soybean Association has organized the farm tours for this afternoon, and they've asked me to remind all of you who are going on the farm tours that

you need to be downstairs in the lobby at 3:00 p.m. – a little cool and cold out, so bring your jacket, bring your clothes, toed shoes. We’re going to be out around farm machinery and things, and you’ll have a wonderful time. So we’re so grateful to Kirk Leeds and Linda Funk and the Soy Foods Council, Iowa Soybean Association – they’re great sponsors, great friends. And this was a deal we cut to do this, and a great success, a great addition to our program. And usually we complain when it’s raining, but the farmers will be so happy to see you in the rain.

Secondly, I hope everyone has a chance to notice that you all have nice globes on your table, but here at the head table we have a centerpiece, which is drip irrigation, and all done in honor of you, Dr. Hillel. And we were trying it out in my office, and it dripped a lot and we had a flood. And the drip irrigation doesn’t always work over at the Hall of Laureates, and sometimes we’re overadjusting that. And before you leave town, we’re hoping you could stop by and take a look – maybe there’s a couple of adjustments over at the Hall of Laureates.

Anyway, we’re to the point in the program where we have the presentation of the diploma, the laureate diploma, and also the presentation of the cash prize. So I would like to invite our chairman, John Ruan III, to come to the stage and join me. And Al, would you be willing to come up and join us as well? And now if we could have Dr. Daniel Hillel come up to the stage. And, you know, I was once a witness in court, and the attorney, the defense lawyer who was prosecuting me took my notes away from me. And so I’ve taken Daniel’s notes away for a second.

[Daniel Hillel: You’re prosecuting me.]

Exactly.

[Daniel Hillel: I plead guilty.]

So maybe we could just stand over here with you and John and maybe move over slightly so we don't have... Al, come over here. Yes, all right. You get in the middle between them, Daniel. Choreographer. And so I’ll read this: “The World Food Prize presented to Dr. Daniel Hillel in recognition of your monumental achievements in ensuring an adequate supply of food for all humanity. Des Moines, Iowa, October 18, 2012, signed by our chairman John Ruan III and myself. ...with my blessing.

Now, you know, diplomas are okay, but John’s got the real prize in his pocket. John, do you want to say something?

John Ruan

Well, I didn’t have a chance to check on this. Ken kind of cheated the other night. He had an envelope that was just for show, but there wasn’t anything inside it. But I am told that there is something inside this, Dr. Hillel, so congratulations.

Ambassador Quinn

One more picture – passing the check. The check’s not in the mail.

Daniel Hillel

I've always been told that the check is in the mail.

Ambassador Quinn

Yeah, we're a very thrifty foundation – we could save the 45 cents, and it's going up to 46 cents. We saved the money on the stamp by giving it to you here.

John Ruan

I was going to say one last thing. My father always had a thing called "passing the check," which he had a picture of a friend of his, and it was the check for the meal after dinner. And he was going like this.

Daniel Hillel

That's like passing the buck.

Ambassador Quinn

And now, Daniel, the floor is yours for your laureate lecture.

LAUREATE ADDRESS:

Daniel Hillel

2012 World Food Prize Laureate

Thank you so much. I'm reminded of the member of Knesset in Israel who asked for the right to speak, and the speaker of the house admonished him. He said, "You have the right to speak, but you are confined to five minutes." And the parliamentarian said, "I accept. But before I begin, I'd like to say a few words."

Before I begin I would like to say my heartfelt thank you to everyone here – Mr. Ruan. Needless to say, to a gentleman here whom I admire greatly, who has created all of this, Ken Quinn.

And now I wish to tell you something about water use efficiency and irrigation. Since ancient times traditional irrigation had been based on the seasonal inundation of land in the floodplains along rivers when those rivers were in spate. Seasonally these rivers rose, overflowed their so-called floodplains and saturated the soil. And some hundreds of years or thousands of years after the advent of farming in the rainfed areas of the ancient fertile crescent in the hills and intermontane valleys, which received the benefit of seasonal rainfall sufficiently to allow the growth of domesticated plants became crops – wheat and barley and oats and rye and lentils and some of the fruit trees, pomegranates and almonds and so on – some hundreds or thousands of years later, people learned to take the seeds of the crops and plant them along the river valleys after the recession of the floods when the soil was completely saturated.

And so crops could be grown utilizing the moisture stored in the soil between successive riverine floodings. Under the system, the soil underwent alternating cycles between brief saturation and gradual extraction of moisture, leading to eventual desiccation. Soil moisture thus shifted from one extreme condition to the opposition extreme, from satiation, that is, excess moisture and therefore restricted oxygen to roots. Roots need to respire the same as do leaves, stems and so on; a plant needs to respire, and it does not have what we have, which are lungs and a circulating system able to transfer oxygen into the various parts of our body and exhale carbon dioxide. Roots need to respire, most mesophytic plants, that is, most crop plants.

And so in the traditional mode of riverine irrigation, soils were alternately excessively wet, limiting respiration of roots and then gradually desiccated so that the roots and the plants began to suffer what is called moisture stress. And when irrigation was supplied in excess, the water table began to rise. The water table rising produces a process of capillary rise and evaporation, enhanced evaporation at the surface, which concentrates salts.

And so gradually river valley irrigation in the ancient Near East, that is in the valley of the Tigris and Euphrates and the Nile and the Indus River Valley underwent a process of waterlogging and in some cases salinization. People who read about the history of these ancient civilizations read about the kings that rise and the battles that are fought, but they don't often realize, nor do classical historians, that what undermines civilizations very often is mismanagement of land and water and crops and agriculture – the very basis of subsistence, the very basis of life. So that was the problem with infrequent, periodic flooding.

Over the centuries, these processes were continued and civilization after civilization, not only in the ancient Middle East, the so-called "Cradle of Civilization," but also farther east and in recent times in Central Asia and in the Americas as well. Irrigation was not sustainable.

Now, the irrigation of Egypt, by the way, was unusually stable, and that is because over most of its length the Nile River runs below the level of the land. It cuts its course so that periodically when the river drained, it also carried away the excess salts. Therefore, the civilization of Egypt was more stable, not entirely so but more stable, than the civilization of Mesopotamia and then the Indus River Valley and so on.

But in recent years, we know in recent decades, the Egyptians, because of the increase in population – the statistic is startling, by the way – as far as we know, as far as archeologists and historians are able to reconstruct the history of Egypt, its population fluctuated over the many centuries, the millennia, of Egyptian civilization, between about a million and a half and two and a half million, perhaps as many as three million. And that was indeed the size of the population of Egypt in the early part of the 19th century, around something like 200 years ago when Napoleon invaded Egypt in 1797 or so.

And he brought with him demographers. His interest, of course, was disrupting the British Empire and fighting and so and so forth. But incidentally he brought some scientists and demographers who studied Egypt and established what is known as the "science of Egyptology." And they even deciphered - they found the Rosetta stone and were able to the ancient Egyptian hieroglyphics and read the records of the past civilization.

And among other things they did was to count the population of Egypt, and they found it, as I said before, to be of the order of two and a half to three million. What do you guess the population of Egypt is today? Anyone else? We're holding an auction here. Eighty? Okay. It rises inexorably about a million and a half for a few years, and so it is now nearly 90 million. That is at least a 30-fold increase on the same land and water basin. And this requires tremendous intensification.

And for that purpose, the Egyptians rightly sponsored the damming of the Nile, with the aid of the Soviet Union. And the damming of the Nile holds back the water so that they are now able to deliver the water continuously, perennially, every month of the year. They have all that water stored behind the Aswan High Dam, and now the land is no longer flushed annually, and the soils of Egypt, especially along the Nile Delta, are undergoing a gradual process of salinization. That was the process to which Egyptian civilization seemed immune over the many centuries. The civilization of Mesopotamia and of the Indus River Valley farther east succumbed to that.

In modern times the same pattern of irrigation was used – riverine irrigation, drawing water from the rivers, applying water to the land. And in Central Asia we have the example of Uzbekistan and the valley of the Amu Darya and Syr Darya flowing into the Aral Sea, that is a lake in Central Asia. The extraction of water during the Soviet time – in that part of the world, they wanted to raise a lot of cotton. And so they decided that they were going to divert the waters of these rivers that feed this beautiful, once-brimming lake of the Aral Sea; and they diverted the water, and they began to produce a lot of cotton for the textile mills of the Soviet Union. And lo and behold, that lake began to shrink, and the irrigation with excess water raised the water table, increased the evaporation and the concentration of salts, and now vast areas in

the Amu Darya and Syr Darya Valleys are severely salinized. And the Aral Sea, that beautiful lake that was once brimming with water and filled with fish, now shrunken; and you can see vast salt flats. I was there not very many years ago to advise on rehabilitation of that land, and I was astonished.

Similar processes are occurring everywhere, particularly in arid regions where water is diverted for irrigation and irrigation is supplied in excess. But that model of irrigation was used in the United States as well. The Mormon people in Utah were the first to divert the waters of the river that they called the Jordan River, patterned after, in their devotion, to the Biblical writ similar to the Jordan River, which itself, by the way, is now undergoing a process of salinization by diversion; and the deprivation of the inflow to the Dead Sea and so on. These processes are very typical and very widespread in arid regions.

Now, in the 20th century, sprinkler irrigation systems were developed, so water no longer needed to be conveyed through open canals and with excess seepage and flooding of the land periodically. You could apply water by sprinkling. And that was more economical, but it required pressure and expensive equipment. And therefore to economize, people tried to use portable sprinkling tubes. The tubes were aluminum or steel, and steel tended to corrode; so aluminum piping seemed to be the order of the day. But that needed to be shifted from place to place, and once again it was repeated low-frequency, high-volume irrigation.

And a theory was developed by professors at the University of California that water in the soil is equally available to plants from what they called "field capacity," that is the maximum amount of water that the soil can hold, down to the wilting point of plants. Theory of infrequent irrigation - you come back and irrigate every week or two or three or four when moisture in the soil is depleted to the point where plants are just about to wilt. So this theory of equal availability for many decades was "*de rigueur*". It was the standard theory, equal availability, wilting point field capacity.

Then in a faraway little country called Israel people came into the practice of irrigation, and these people were not old-time farmers. They were new to the entire practice of irrigation, and therefore they were willing to try new things. And it occurred to them that maybe if we apply the water slowly, one drop at a time, instead of flooding the land, instead of high-volume, low-frequency, let's apply the water at low-volume, high frequency, or continuously.

And the idea was an interesting idea, and in fact it was not entirely new. People out in the western states in the post-war years conceived a similar idea and developed - because agriculture is practiced in the United States on a larger scale, especially in the West, they developed these center-pivot irrigation systems that turned around. And you can see when you fly over these states in the West, you'll see this pattern of circular green fields - water pumped through vertical pipes, and there's a horizontal boom that circles around continuously and drips water. And that system was really a system of high-frequency, lower-volume, but still a high volume. But it could not be applied throughout the world, because these are very expensive rigs, and they require high pressure and large volumes of water.

People in North Africa centuries before had conceived of a very ingenious and very simple way of irrigating. When they planted trees, they buried ceramic pots next to the saplings, next to the tree plantings, and filled them periodically every week or two. And these unglazed ceramic

pots, the porous pots, oozed the water into the root zone. That was an ingenious way to do it, but it did not spread very far from there.

The idea of high-frequency, low-volume irrigation suddenly became practical in the post-World War years, especially in the late fifties and early sixties, when weathering-resistant, plastic tubing, PVC and polyethylene tubing became available. And it was cheap; it was a byproduct of the petroleum industry.

And these tubes, very narrow tubes, not much more than half an inch or an inch in diameter, could be perforated or could be made porous or could be punctured and little emitters attached to them so the water could be applied continuously at the base of a plant into the root system and in response to the needs of the plant. A young plant requires little water, an older plant requires a little bit more water, and you can fine tune the delivery of water in response to weather conditions, whether there's a heat wave or a rainstorm. During a rainstorm you don't have to apply any water, but during a heat wave you need to apply a lot of water and during season, of course, and in response to the stage of growth of the plant.

That was the essence of drip irrigation – such a simple idea. Later on people found ways of improving the system. For example, you could inject fertilizers into the water supply so that you feed the plants as well as water them. You could even inject pesticides into the water wherever necessary to overcome diseases or other problems that the plant encounters. And this simple idea spread.

Another variation is to apply water through porous tubes that have many, many little, not perforations but many little pores, and the tubes can be placed below the surface of the ground so that the tube, this porous, plastic tube, oozes water into the root zone. There are many variants.

And this then, of course, requires ancillary devices, such as pressure control so that the pressure doesn't fluctuate, and in addition to that, fertilizer injection, pesticide injection as necessary.

This simple idea spread. It is now gone irrigation from low-frequency, high-volume to high-frequency, low-volume irrigation – high frequency or continuous. And other variants of it are micro-sprinklers that can spread the water, depending on whether in the soil water spreads laterally or just goes vertically and so on. And lo and behold, the crop per drop – if I made that noise, it was on purpose. I want you to remember – crop per drop.

So that is the essence and the development of flexible, portable pipes made the low-cost, plastic materials available, and the rest is history.

But now we have another problem, an entirely different problem, unanticipated. Before the Industrial Revolution, the atmosphere contained something like 270, give or take, parts per million of carbon dioxide. Carbon dioxide has an interesting property. It allows the penetration, or it transmits radiation of a certain type that is shortwave radiation, but it does not allow, it inhibits the transmission of longwave radiation. Longwave radiation is heat radiation. It happens that we receive on earth a shortwave radiation from the sun, and it is absorbed by the ground, the soil, the rocks, plants; and then what they emit is longwave radiation – depends, of course, on the temperature of the radiating body. Longwave radiation dissipated, except for this

greenhouse effect that makes the earth's surface warmer than it would be otherwise if it didn't have an atmosphere inhibiting the out-transmission of this longwave radiation.

Since the Industrial Revolution, we've been burning more and more fossil fuels – coal and then petroleum and its various derivatives, and we have enriched the atmosphere, “enriched,” quote, unquote, the atmosphere from about 270 parts per million to very nearly 400 parts per million. We're well on our way to doubling the concentration of carbon dioxide. And carbon dioxide is not the only so-called greenhouse gas. Why greenhouse? Because it resembles the effect of a plate of glass transmitting light and inhibiting the outflow of heat.

There are other gases. There's methane and there's nitrous oxide, and all of these have been increasing, ozone as well.

And so we are in the process of warming the surface of the earth. Nobody suspected that until not very many decades ago. Nobody quite noticed it. It was predicted by some scientists but largely ignored.

So we are now projecting... Various calculations by scientists project that the temperature is due to rise by perhaps four degrees Celsius on average by the end of the century. And this may be associated with the reduction of rainfall in some areas and altogether more extreme weather events. A warmer world is a more intense world weatherwise. And furthermore, melting of icecaps would cause the rising of sea levels and threaten to reduce agricultural yields in some regions, particularly along coasts and maybe to inundate a city or two, perhaps New York, perhaps London, a few other larger or small cities. And so it is a serious matter, a very serious matter.

And the risk is very high. There is some controversy over this, but the science seems in principle very clear. Quantitatively there are still some doubts, because we can only project into the future using models, and models are in some ways figments of the imagination, or they portray mathematically what we perceive to be the major processes and properties of the earth's system. So there's not any great certainty, but there is a high probability that the temperature will rise significantly in the next few decades, by the middle of this century.

Agriculture is involved in this, because agriculture is an emitter. It's a net emitter. When we clear land and begin cultivating, the original store of organic matter in the soil is rapidly decomposed, and the soil then spews out carbon dioxide. And if the soil is saturated, then it will also spew out nitrous oxide and methane.

So we need to change the mode of agriculture. We need to be able to irrigate more judiciously to prevent saturation of the soil, to prevent the erosion of soil, to conserve soil. Agriculture is a component, an important component, and agriculture can play a very positive role because in many cases soils can be changed from net emitters to net absorbers. We can enrich the soil with organic matter, in the process increase soil fertility and improve soil structure. And soil agriculture can either play a negative role or a positive role, depending on how we manage it.

I could be talking about this endlessly, but I want to make a plea here for improving agriculture, improving the yields per unit of land so that we don't have to extensify agriculture, we don't have to destroy natural ecosystems by expanding agriculture needlessly and then degrading the

land. We have to intensify agriculture, letting ecosystems remain natural ecosystems, tending them.

The Bible tells us, the first chapter of the Book of Genesis tells us that God placed the human Adam. What's Adam? We don't know Adam from Adam in English, but in Hebrew Adam is the masculine form of the noun Adamah, meaning "earth." Therefore Adam means literally "earthling," of the earth. And Eve, which we mispronounce – the original name is Hawwāh meaning "life." Therefore, Adam and Eve, Adamah and Hawwāh mean literally "soil" and "life." There is powerful symbolism in this.

When they began to abuse their privileges, they were expelled from the Garden of Eden. It's for us now to stop abusing soil and water to fulfill our real destiny, being stewards of the land, stewards of the water, stewards of the earth, and return to the Garden of Eden.

Now I want to tell you a story before I finish. In the lore of the much-too-conflicted Middle East there is an old story called, "The War of Basus." In ancient times, so the story goes, two neighboring tribes had coexisted in a tenuous state of peace. They shared a single well located on the boundary between their territories. Each tribe had access to the water from its own side of the common trough. One day a camel belonging to one tribe wandered across the boundary and drank water from the wrong side. Incensed at this breach of his tribe's sacred territorial rights, the son of the Sheikh, the Sheikh, whose realm had been violated, rose up in anger and killed the offender. Alas, that hapless creature just happened to belong to the son of the neighboring Sheikh, who then rose in anger to smite the killer of his beloved camel. There began a blood feud between the two tribes that lasted five generations and cost the lives of countless people on both sides. It was known as the War of Basus, though no one remembered that Basus, the original cause of the strife, was only an errant camel.

When the conflict eventually ended, neither tribe could claim victory, and both were relieved to reestablish their reciprocal arrangement. Even the self-generating hatred born of this violence could not prevail over the imperative to resolve the dispute and restore an equitable water supply for all.

That's my message.

Do we have a view here? Do we have a view? Can we have that slide? Okay. I have a few more words.

Please look at that slide. A view of our earth from space should help us to restore the true perspective. It shows the planet whole, without political or sectarian boundaries. How beautiful, how colorful, how delicate is this ball of lapping waters, floating continents and swirling clouds gliding in a thin veil of air. And how small and solitary is this one and only home of ours, how unique its life-generating attributes, and how vulnerable its biosphere – soil, water and air. And how interlinked its ecosystems. We must listen to its signs of distress, for it is heir apparent, and we are all its dependent children.

Ambassador Quinn

Daniel, that's so wonderful, so wonderful. You're so far above my...

Daniel, what another wonderful World Food Prize moment you have created. You've touched everyone's hearts here today. Thank you for being so wonderful. Thank you for all your amazing accomplishments. Thank you for having chosen a wonderful woman to be your wife... It's been our great privilege to have you here.

So thank you all for being here. Let's finish the lunch with one more round of applause for Daniel Hillel.