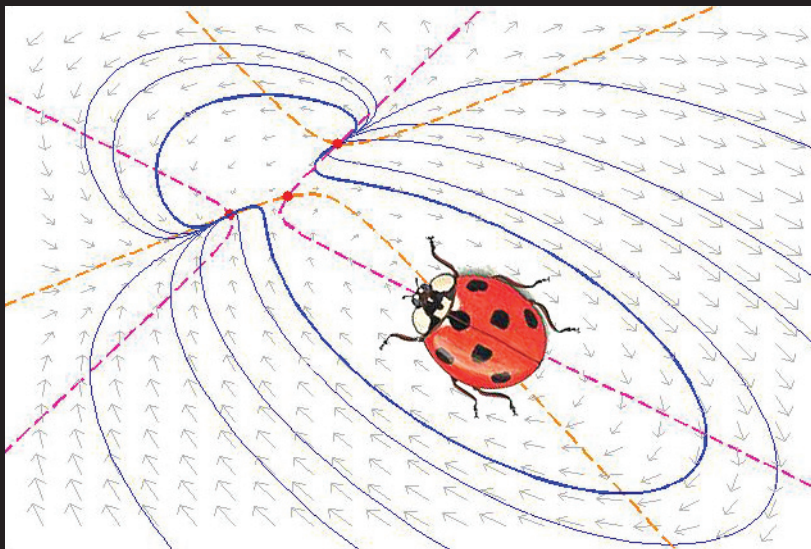




56TH ANNUAL HARRINGTON LECTURE



*Research in Mathematical
Ecology and the Struggle
for Existence*

Presented by

DR. JOSÉ D. FLORES

Professor of Mathematics

Tuesday, September 23, 2008

7 p.m.

Farber Hall, Old Main



The University of South Dakota

COLLEGE OF ARTS & SCIENCES

*Research in Mathematical
Ecology and the Struggle
for Existence*

Presented by
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The Fifty-Sixth Annual Harrington Lecture
Presented to Faculty, Students, Family, and Friends
in Farber Hall – Old Main at
The University of South Dakota, Vermillion
Tuesday, September 23, 2008

The Harrington Lecture is named in honor of Elbert W. Harrington (1901–87), Professor of Speech and Dean (1945–70) of the College of Arts and Sciences. Each year a committee of the faculty of Arts and Sciences selects a member of the faculty to be honored with the privilege of delivering the annual address. In the words of the original charge “The lecturer shall be one whose record as a scholar teacher is in the best liberal tradition, and whose achievement warrants recognition by the entire College”; and the speaker “shall prepare a non-technical lecture on some phase of liberal education in which he/she shall relate part or all of his/her own subject matter field to the whole concept of the liberal arts.”

Originally called the “Annual Lecture on Liberal Education,” the name was changed in 1966 to honor the man who conceived the series and delivered the fourth lecture.



2008 HARRINGTON COMMITTEE

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Research in Mathematical Ecology and the Struggle for Existence

INTRODUCTION AND REMARKS

Dear Dean Moen, Provost Staben, colleagues, members of the past Harrington lectures, students, friends, ladies and gentlemen:

I would like to thank the Harrington Lecture committee for the selection; I also would also like to congratulate the next year's lecturer. It is certainly a privilege to become part of this distinguished group.

I am as flattered for your presence here tonight as I was the moment when Dean Keller notified me of the honor of being selected the Harrington Lecturer for the opening of the 2008 academic year. It was one of these requests that you cannot refuse; it touches your arrogance, and at least that was my case.

There are a good number of friends in the audience that I would like to thank, but I dare not mention any by name at the risk of missing one and regretting it. However there are a couple of names that I cannot omit if I want to survive the struggle of my own existence. I cannot thank Kathy Nelson enough for taking care of the details of this event. In addition, without the creative design work of Terry Dyvig, my poster would be blank.

I would like to introduce my family, starting with my wife Wilza Schmied, a Pediatric Physical Therapist for the Harrisburg's School District. Wilza has shared with me all my ventures for the last 29 years, nine months, 10 days and 23 hours. If you convert it in days, and then in hours, and finally in minutes, plus or minus the 31st day of some months, a good approximation is about 15,602,220 minutes; for each of these minutes, I have loved her the complete 60 seconds.

Next, I would like to introduce our daughters. Our oldest daughter Francisca Alejandra graduated from the University of Iowa with a degree in Neurosciences and is currently working in clinical trials at the Center for Pain Medicine at the UCSD Medical Center in San Diego, California. Our youngest daughter Xaviera Paz graduated last December 2007 from The University of Nebraska-Lincoln with a degree in Film Studies. She is currently applying to graduate school in Film Preservation.

On a serious note, I would like to dedicate this 56th Harrington Lecture to Dr. Alex Mehaffey, Jr. Alex Mehaffey passed away last October 12, 2007. Dr. Mehaffey led the department of Mathematics as chair for many years before he retired in 1995. Everyone who knew Alex knew about his love for woodworking. He could talk for hours about his grandfather clock collection. On the academic side, Alex Mehaffey's mathematical passion was in the history of mathematics, a topic that ignited him very easily.

Soon after I arrived to USD he took the time to give me my first private lecture about Anna Pell and her husband Alexander Pell, both of whom were members of the Mathematics Department at USD at some point in the early 1900s. As Alex

wrote in his work “Anna Johnson Pell Wheeler: A Centennial Tribute” (Mehaffey, 1990), Alexander Pell had an eventful life before he came to Vermillion. It was not until after his death that the University community discovered that his real name was Sergie Degaev and that he was a Russian double agent. He had sought safety in the United States after incurring the wrath of both his revolutionary group and that of the Russian government.

Anna Pell, Alexander’s second wife, earned a master’s degree at the University of Iowa. She got her Ph.D. in mathematics at the University of Chicago and her research area of interest was integral equations, which coincidentally was my research area at the University of Iowa. He remarked the coincidences and he certainly joked about the “double agent” thing. Dr. Mehaffey guided my first steps as a faculty here at USD, and I certainly think he deserves credit for me being here tonight.

It has been 35 years since this lecture was delivered by a member of the Math Department. Dr. Howard Connors delivered his Harrington lecture in 1973 (I was in college then). Previously, Dr. Marjorie H. Beaty was the first member of the Department of Mathematics to deliver the Harrington Lecture, back in 1965 (I was freshman in high school then). She was followed by Dr. William E. Ekman in 1968 and Dr. Wayne W. Gutzman in 1971. That makes me the fifth member of the Mathematics Department to have the honor to address this lecture to the College of Arts and Sciences.

By now many of you have realized that my native tongue is not English, and you are set to enjoy this cute Spanish accent for the rest of this lecture. Also, as you all may be able to discover by looking at the pamphlet with tonight’s program, I stand on this podium as the first Latino to deliver this lecture. I have the feeling that Dr. Harrington would be very pleased of the fact that this lecture has finally expanded diversity.

With this introduction behind me I am ready to pursue with the lecture which is in some way biographical, and I have selected this peculiar title to describe the journey that has brought me to stand here tonight.

BIOGRAPHICAL SKETCH

I come from the southern hemisphere of this very ill planet, which is currently suffering global warming due to the careless development and adaptation of our habitat. I was born in Chile, a long and thin, beautiful place in South America.

As described by Isabel Allende in her book “My Invented Country” (Allende, 2003):

“Chile [is] that remote land that few people can locate in the map, because it is as far as you can go without falling off the planet...Nobody passes by casually, however lost he may be, although many visitors decide to stay forever, enamored of the land and the people. Chile lies at the end of all roads, a lance to the south of the south of America, four thousand three hundred kilometers of hills, valleys, lakes, and sea.”

I was born in a mining town located in the heart of the Atacama Desert, the driest place in the world. It was a town that symbolized the Chilean working class; it used to be the center of the Chilean economical and cultural activities in the middle of the past century, where the exploitation of nitrate (saltpeter) was the principal source of economical activities. I was the first son of Carmen Garcia Castillo and Fernando Flores Allende. All my parents could hope for was for me to become a police officer, a much respected position, but all that could be afforded with only a secondary education.

I attended elementary school in what was an old farm house. Two teachers took care of four grades accommodated in the main room of the house and on the front porch - maybe not too far from what many of you experienced. When we raise the flag to sing the national anthem every Monday it would not be rare for a duck, chickens or a pig to make an appearance. Since my father's job required that we move many times, I recall having attended fourth grade in three different rural schools. Always moving with the desire to find a place with better learning opportunities, we finally moved to Santiago, the capital of Chile, in the early 60s. There I was able to attend public high school and my secondary education was somehow normal with no relevant incidents.

Unlike the system here in the United States, students are placed in their majors their senior year of high school. I was placed in the math kids' group (internationally known as the nerds) because I could count without using my fingers. We were the only math senior group and were considered to be the future engineers and mathematicians. The other groups were the chemistry-biology group, which consisted mainly of those who wanted to be medical doctors, and then finally the art and humanitarian sciences group, whom we referred to as the "Poets". As a side note, these divisions were also a good split for soccer teams for the intramural (brutal) soccer tournaments. I liked playing defense because the position required very little skills and abided by one simple rule: one and only one object is allowed to get by me, the ball or the opponent player, never both. I followed this rule strictly and it secured me a first string position for as long as I played the game.

In my home life at the time while my father was not around, I had the good fortune of being raised by my wonderful mother who guided me and taught me life lessons in honesty and dignity. She taught me that being a good person isn't a hard thing to do, one just needs to be good in all aspects of what they do whatever that may be. Knowing this not only helped me be a good person (I believe), but also helped me be a good friend to others and helped me form lasting friendships. I am actually still friends with the same kids I hung out with in my neighborhood. In fact, I see to it that I visit them every time I go back home. We formed not only a bond of friendship, but became a support system for each other. Against everyone's expectations, my friends and I were determined to become the first generation to achieve a university education and career in our neighborhood.

My teen years were certainly inspired by the movement of May 1968 in France where a series of student protests and strikes gave origin to what was called the “French May”. It was an event that shocked the planet and provoked a mental change, showing that young people just wanted to “get off” the globe and “demanded the impossible”. That May lasted 12 months. It affected all societies and countries, and Latino-America was no exception.

The May Movement inspired the idea of reform, the idea of change, and called for restructuring a society that was obsolete and archaic. This global incident motivated us as well to become what we dreamed of becoming: an actor, an architect, a lawyer, an engineer and a mathematician. Because of this intellectual ambition we were seen as role models for other friends and families in the neighborhood. We made it our goal to support each other in whatever way needed to achieve our educational endeavors.

We educated ourselves in matters that none of our parents could have helped us, that is, the meaning of achieving a university degree. It was not only the idea of getting a diploma; we wanted to be a realistic contribution to our society. Inspired by the ideology of the May Movement we not only wanted to be part of the change we wanted to be that change itself. Our goal was the university; it was our destiny.

Everything worked out somehow as planned. Our persistence paid off. I was admitted to the School of Education where I could pursue a degree in mathematics, but what I really wanted to do was continue mathematics at the Faculty of Sciences and obtain a master's degree. I wanted to achieve more than teaching and doing research, but that would have to wait.

My first years as a university student were great. I was doing what I was supposed to do – i.e., performing well in the courses, but participating very actively in other extracurricular activities. We did a lot of voluntary community work. Most of our free time was spent helping build housing projects and other community activities in low income neighborhoods. My adolescence was marked by the need to help people that did not have the same opportunities as I did. I enjoyed my days as a university student, and I was a very happy math major. I felt intellectually privileged, like I was a small part of society with serious responsibilities... however, it did not last long. (Again I would have to wait.)

On Sept. 11, 1973 - my first 9/11 - the military took control of the country. The military coup, with the army rolled up in full battle gear, attacked the presidential palace (photo), causing the death of thousands of citizens, among them President Salvador Allende. They suspended Congress indefinitely, disbanded the Supreme Court, banned individual liberties and political parties, imposed absolute censorship of the media, and finally, over time, attempted mercilessly to extinguish every dissident voice. The military junta presided over by Augusto Pinochet and orchestrated by the Nixon Administration under the direction of the Secretary of State Henry Kissinger ruled 17 years of the most brutal dictatorship we have ever known.

As in many of these democratization events “truth” is the main casualty; education does not become a priority. At most institutions of higher education, intellectuals and university professors were targeted. At some point, as many as 500 thousand people fled the country by seeking asylum in embassies of foreign countries, or simply by hiking on trails (paths) over the Andes to reach Argentina. Many of these escapees were doomed to be victims of the Operación Condor, a treaty between the dictators of Chile, Argentina and Uruguay, to pursue nonconformists and free-thinkers regardless of their nationality. Amnesty International has reported 29,000 tortured, 3,200 killed and there are about 1,100 still missing.

Universities and centers of higher education were closed and later opened, but ruled by the military authority. It was not easy to return to class; in most sites a soldier with a machine gun would take your ID while you attended class every day. Those were very difficult days and the situation was very tense. It was not unusual for a soldier to walk into a classroom, identify a person and take him or her away, never to be seen again. I was in a more apparently calm environment. While I was working as a part-time math teacher in a public high school, I attended the graduate school. It was there where I became interested in pursuing Ph.D. studies.

Since such studies were limited in Chile, I applied and was accepted to the University of Iowa in 1982. While still completing my Ph.D. thesis, I arrived at USD in the fall 1989. I spent the first half of the 1990s trying to move my visa status from “temporary worker” to “permanent resident”. I must acknowledge the great help and support I received from Alex Mahaffey; he always seemed pleased with my performance as an instructor as he helped me to go through all the paper work to obtain the green card. He was one of the reasons I accepted the job at USD. He was a man of few words but very sincere; we connected easily. He was a good mentor. He understood that it was time to encourage new faculty to become more involved in research and make it our academic responsibility. I understood the message and I acknowledge my responsibility assuming my own struggle for existence.

RESEARCH MOTIVATION

The title of this talk is taken from one of the first books that attract me to study Mathematical Ecology. This motivation is summarized in the definition given by G.F. Gause, a Russian biologist in his book “The Struggle for Existence” (Gause, 1934):

“Darwin considered the struggle for existence in a wider sense, including the competition of organisms for a possession of common places in nature, as well as their destruction of one another. Darwin showed that animals and plants, remote in the scale of nature, are bound together by a web of complex relations in the process of their struggle for existence.”

The human being is not excluded from the general concept of the struggle for existence. Look for instance at the issue of the starvation of large populations in African countries is certainly a severe struggle for existence and survival (show photos). Immigration of large populations of individuals from underdeveloped countries not only to America but also to more stable countries, is nothing else but part of a struggle for existence.

As with any other species in nature, humans also search for a habitat which can provide them a source of food and a safe refuge. Guided by the moral values of the education I received at home, I see immigrants as individuals that are just looking for resources to provide their families a better life. These are individuals, who if provided with education and therefore a better future, can be capable of making a significant contribution to our society. For instance, “English Only” is a concept that not only isolates us as a society but also weakens us in our struggle for existence. We become a society that does not understand the natural changes that we have experienced ourselves.

For me, my own struggle for existence in academia is my struggle for research.

A BRIEF HISTORY OF MATHEMATICAL MODELING

The area known as applied mathematics serves the study of what is called “real-life” mathematical applications. In general terms we have the idea that in ancient times geometry and arithmetic were developed to solve problems that pertain to the reality of that time, such as the motion of the planets and the construction of big architectural structures – like the pyramid. Later the development of physics, with Isaac Newton and his apple problem (not the iPod), took a great credit when studying relativity. Newton along with Leibnitz, the fathers of Calculus, developed this area of applied mathematics, which also became known as the “Language of Change” because it is dedicated to understanding quantitatively phenomena that experiences continuous changes.

While research in the area of mathematical ecology has only developed rapidly in recent years, there is evidence of applications of mathematics to biological problems as early as the year 1200. The work of Leonardo of Pisa presented the following model in his book of calculations, the “Liber Abaci” (Pisa, 1202) : Start with a pair (M and F) of immature rabbits at the beginning of a breeding season; after one season they can reproduce and produce two pairs of immature rabbits. The parents then stop producing but after another season their offspring produce two pairs each and then stop. The process continues in exactly the same way. In the 17th century the model was renamed Fibonacci and generates the series 0, 1, 1, 2, 3, 5, 8, etc.

In the field of mathematical ecology, a broad range of models serve different objectives. For instance, strategic models are needed for isolating theoretical questions and studying them one at a time. They are also required for formulating the appropriate control policies in the managements of a particular renewable resource or a specific pest population. In this case, the user of the model needs

to have a good understanding of the behavior of the model. The solution of these applied problems is very important in order to maintain strong support for ecological studies. The analyses of the models of an ecosystem may provide useful guidelines in the construction of a detailed simulation model. They can also provide suggestions on how to exercise a computer model of a community.

THE NUTS AND BOLTS OF MY RESEARCH

My career took a big step in the fall of 2000 while attending the National Congress in Computational and Applied Mathematics (Congresso Nacional de Matemáticas Aplicadas e Computacional) in Santos, Sao Paulo, Brazil. I presented a paper in Numerical Analysis titled Iterative method for numerical solution of Laplace's equation in a non-simply connected domain in 2-Dimensions (Flores, 2000). A very long and complicated title, the topic is complicated too. At that conference I had the opportunity to meet and interact with a group of faculty members from Chile; they were presenting in the mathematical ecology session of the conference. Among the members of that group were my Master thesis advisor, Jorge Gonzales, and my good friend and U of Iowa Ph.D. classmate Jaime Mena-Lorca, both well known authorities in the field of bio-mathematics in Latin-America. At the conference we initiated our collaboration by discussing the possibility of integrating numerical and simulation aspects into one of their projects. By the end of the week-long conference we had some project idea lined up to pursue.

One of our projects consisted in developing a mathematical model to control the red spider of the vineyards in the Central Valley of Chile. Vineyards are agro ecosystems that strongly reflect man's historical relation with the land. In Chile, as in many other countries, this kind of agro systems is facing agricultural intensification resulting in the loss of heterogeneity affecting biotic communities. In the particular case of the red spider, the mite attacks the leaves of the vine and damages the foliar area, reducing photosynthesis and therefore reducing the yield of the vineyard. Pesticides could be used to control the pest, but at the sacrifice of the quality of the grape and therefore the wine. A good alternative is to control the pest by artificially introducing its natural predator. In our project we opted for a native Chilean predator of the mite, the *Brevipalpus chilensis*' (Vargas, 2001). The project was originated at the National Institute of Agro-Sciences Research (INIA) in the Central Valley of Chile by the entomologist Dr. Robinson Vargas, Director of the Instituto.

His work is oriented towards providing the Chilean wine producer with information on the managements of the pests in order to produce organic wine of high quality. The field data was provided by INIA and by the end of that year we had some basic research. We presented our first collaborative paper titled Computational Model for a Biological Pest Control at the Latino-American Congress of Bio-Mathematics (Flores, 2002), in Campinas, Brazil. This research was followed by a more elaborated paper, including a computer simulation, which

was presented at the BioComp 2002, whose theme was Topics in Biomathematics and Related Computational Problems at the Beginning of the Third Millennium at the Università di Napoli Federico II, Vietri Sul Mare, Italy. The application of the method, including the information obtained by the simulation of the model, is currently applied in some of the Vineyard in the central valley of Chile.

As we collected information on biological control, we also became interested in modeling the control of the fruit fly (*Drosophila melanogaster*), by means of a method called the Sterile Insect Technique (Knipling, 1955). The method developed by the entomologist Edward Knipling at Iowa State University in 1953 consisted of a simple mathematical formula. The concept is simple: eggs are radiated with alpha-rays, generating a sterile male; the idea is to invade the field with sterile males. Here is where the model takes its part to answer some basic questions on how frequent it needs to be distributed? How far apart? And so on. The results of this paper traveled to Spain to be presented at the International Conference on Mathematical ecology in Alcalá de Henares, Madrid in 2003 (Flores, 2003).

The SIT method has previously been used successfully in several regions of the world, including the U.S., Mexico, and Chile. Since we knew that fruit flies have been a problem of economical importance in the northern part of Chile, it was a good motivation to study the mathematical model for the pest. Students at the Pontificia Universidad Católica de Valparaíso (PUCV) collected data and we developed a spatial model for the control of the fruit fly in the northern region of Chile. Those results were published, and presented in Argentina 2005 at the Latino-American congress of Biomathematics.

As we evolved in our collaboration we moved towards a more theoretical framework of predator-prey models to get a better understanding of the concept of “The struggle for existence.”

We analyzed population dynamics of species by considering the effect of immigration and emigration, harvesting (particularly with respects to the case of species under overexploitation) and the Allee effect (a concept that has been known for some time now but not fully incorporated on mathematical models). Most of our recent research work has been based in what is generally known as predator-prey models. These types of models are based on the original work of Alfred Lotka and Vitto Volterra who worked on experimental data (from two different sources) earlier in the past century (1925).

Bio-economical models can also be used to solve the particular case of open access fishery. In this case, we confront the worthy predator “humans.” The overexploitation of certain marine species reached the point where the international community needs to play a fundamental role in managing the fishery industry. The exploitation of fish population provides some classic examples of disastrous exploitation of renewable resources. A few large fisheries have been destroyed by overfishing. In practice, the management of a fishery is a decision with multiple objectives. The formulation of good harvesting policies,

which take into account these objectives, is a complex and difficult task even if the dynamics of a fish population is known accurately and if the objectives are fully quantified.

With the collaboration of Professor Eduardo Gonzales and Jaime Mena at the PUCV we presented papers in the following research topics: Depensation in a Bio-Economic Models for Open-Access Fishery (Flores, 2006), Allee Effect in Bioeconomic Models, and Allele effect (Flores, 2007), emigration and immigration for a class of predator-prey models (González-Olivares, 2008).

In a more general framework we have done some research on a mathematical model for the “food web”, where the natural environment is not confined to only two populations (predators and preys), rather the natural environment contains many species intermingled. In this area, we collaborated with Dr. Rodrigo Ramos-Jiliberto, a theoretical ecologist at the University of Chile, to extend the results of Hasting and Powell (1998) in a tri-trophic food chain. Our results were outlined in the paper titled Role of Inducible Defenses in the Stability of a Tritrophic System (Ramos, 2008), which was published in the international journal *Ecological Complexity*. In this paper we generalized the theoretical concepts of defense and refuge in a chain with two predators and two preys.

I have had the opportunity to study and learn about many areas of ecology and have seen how mathematics can help understand some of the intriguing mysteries of the dynamics of life. The world of ecology is incredibly fascinating, and I have only scratched the tip of the iceberg. By investigating the concepts of immigration and emigration, I have gained a better understanding that invading habitats, crossing rivers, and jumping walls or fences is part of a natural instinct of a species in its struggle for existence and nothing else.

I recently returned from a trip from Chile where I spent six weeks at the Catholic University in Valparaiso as a Fulbright Specialist teaching graduate students computational techniques to research in mathematical ecology. I worked with a highly motivated group of master’s students; I could not emphasize enough the importance and necessity to improve their English. In a world that becomes every day much more globalized, being monolingual is a disadvantage; just as “Spanish Only” limits them, “English Only” limits us. This Fulbright experience has been amazing. I took on my shoulders the responsibility of being part of US academia, something that I have never done before. I felt very proud of being a USD faculty and in some way I realized that “I deserve USD, as much as USD deserves me”.

The strength of our education, the strength of the liberal arts education, will prepare our students to live in a world that is confronting complex and difficult times. Today we cannot ignore anymore the global warming of the planet, the indiscriminate use of our natural resources, the overuse of energy, the extinction of so many species, the oil crisis, and the senseless wars that plague our human race. These are more political issues than economical or even social issues. In the absence of a major catastrophe, these events are a warning: Change or jeopardize

our existence. We must unite as one human race and together - without politics, religion or borders – resolve our Struggle for Existence.

I am grateful to USD for have given me the opportunity to teach and to perform research of high quality. More than that, I am grateful to the students, collaborators and colleagues who have made this journey what it is. To my students I dedicate my best efforts to teach them whatever I have learned in these many years in academia, and tonight I would like to dedicate the lyrics of the song *You Will Never Walk Alone*, which is actually a show tune from the 1945 Rodgers and Hammerstein musical, *Carousel*.

Walk on through the wind
 Walk on through the rain
 Though your dreams be tossed and blown
 Walk on, walk on
 With hope in your heart
 And you'll never walk alone
 You'll never walk alone

I have to admit I have never seen the play, nor read the script. I learned it by watching soccer. It is the adopted anthem of the Liverpool Football Club and is invariably sung by its supporters moments before the start of each home game.

Lastly, I cannot finish this talk without leaving you with a beautiful poem from one of my favorite Spanish poets Antonio Machado (1875–1939) (Craigie, 1978).

<p>Caminante, son tus huellas el camino, y nada más; caminante, no hay camino, se hace camino al andar. Al andar se hace camino, y al volver la vista atrás se ve la senda que nunca se ha de volver a pisar. Caminante, no hay camino, sino estelas en la mar.</p>	<p>Wanderer, your footsteps are the road, and nothing more; wanderer, there is no road, the road is made by walking. By walking one makes the road, and upon glancing behind one sees the path that never will be trod again. Wanderer, there is no road— only wakes upon the sea.</p>
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Peace, and thank you very much.

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BIOGRAPHY

José D. Flores, Ph.D., was born in the town of Humberstone in the northern region of Chile. He earned his bachelor's degree at the Universidad de Chile in 1973. He taught high school mathematics while completing his graduate studies and received the degree of magister en Matemáticas at the Universidad Técnica del Estado in Santiago in 1977. Flores arrived at The University of Iowa in 1982, where he obtained an M.S. in mathematics in 1984 and a Ph.D. in 1990 in the area of numerical analysis. His Ph.D. research, directed by Kendall E. Atkinson, Ph.D., is titled "Numerical Solutions for Integral Equations of Second Kind." Flores' current research interest is mathematical models derived from ecological problems, particularly in the area of population dynamics. He is also interested in the implementation of technology in the mathematical curriculum.

Flores has taught at The University of South Dakota since 1989. He was promoted to full professor in 2001. He was awarded Teacher of the Year in 1996 by the USD Student Association, and received the Richard and Sharon Cutler Faculty Award in Liberal Arts in 2006. He recently received a Fulbright Senior Specialist grant to teach and perform research at the Universidad Católica de Valparaíso, Valparaíso, Chile, where he taught a course in computational method for mathematical models in ecology.

Flores has been married to Wilza Schmied, a pediatric physical therapist, for 29 years. For 27 years, he has been the father of Francisca Alejandra Flores, who obtained a B.S. degree in biology from the University of Iowa in 2004 and for 22 years he has been the father of Xaviera Paz Flores, who graduated in December 2007 from the University of Nebraska-Lincoln with a B.S. in film studies.

FORMER HARRINGTON LECTURES

Arthur McCay Pardee, Chemistry, <i>The Making of a Teacher</i>	1953
Herbert Samuel Schell, History, <i>The Professor Under Fire, 1954 Version</i>	1954
Edward Perry Churchill, Zoology, <i>I'd Rather be a Professor</i>	1955
Elbert W. Harrington, Communication, <i>Procustes on the Campus</i>	1956
Elmer Godfrey Trotzig, Journalism, <i>Is it Good-by to Book Learning?</i>	1957
Grace L. Beede, Classics, <i>The Classics in the Geophysical Year</i>	1958
William O. Farber, Government, <i>Changing Concepts of Public Service</i>	1959

Edwin H. Shaw, Jr., Biochemistry, <i>This is Your World</i>	1960
Edward C. Ehrenspenger, English, <i>The Odyssey of an English Teacher</i>	1961
Edgar Paul Rothrock, Geology, <i>The Challenge of Science</i>	1962
Thomas C. Geary, Government, <i>Liberal Education: Useless or Useful?</i>	1963
Alexander P. Hartman, Modern Foreign Languages, <i>Literature in the Space Age</i>	1964
Marjorie H. Beaty, Mathematics, <i>Progress and the Professor</i>	1965
Cedric Cummins, History, <i>As it was in the Beginning: The University of South Dakota</i>	1966
Warren M. Lee, Theatre, <i>The Shoemaker and the Wolves</i>	1967
William E. Ekman, Mathematics, <i>The Mathematical Tree of Knowledge</i>	1968
Charles R. Estee, Chemistry, <i>Nostalgic Hamburger</i>	1969
Harold M. Jordan, Communication, <i>To Speak as Men</i>	1970
Wayne W. Gutzman, Mathematics, <i>Speak to Us of Teaching</i>	1971
Wayne S. Knutson, English, <i>A Narrow Escape into Faith</i>	1972
Howard W. Connors, Mathematics, <i>Around the Corner</i>	1973
Alan L. Clem, Government, <i>A Curious Profession</i>	1974
Henry V. Cobb, Psychology, <i>Confessions of a Rolling Stone</i>	1975
Sylvester Clifford, Communication, <i>Sentimental Journey</i>	1976
Gottfried I. Moller, Physics, <i>Science in an Age of Gadgeteering</i>	1977
Raphael H. Block, English, <i>The Shoulders of Giants</i>	1978
Nancy Noble Skeen, Philosophy, <i>The End of Liberal Arts Education</i>	1979
Carl Sipprelle, Psychology, <i>Stereotypes and Alternative Life-styles in Aging</i>	1980
Martin Busch, Communication, <i>Television News: Writing on the Wind</i>	1981
R. Alton Lee, History, <i>Sputnik and the Liberal Arts</i>	1982
John R. Milton, English, <i>The Ethics of Gratitude</i>	1983
George P. Scott, Chemistry, <i>A University in the Power Struggle</i>	1984
Theodore Van Bruggen, Biology, <i>Our Prairie Heritage</i>	1985
Duncan J. McGregor, Geology, <i>A Solemn Equation</i>	1986
Gilbert M. French, Psychology, <i>Human Resources: Fewer Limits, More Opportunities</i>	1987
James Schmulbach, Biology, <i>Marsh Legacy</i>	1988
Norman E. Miller, Chemistry, <i>When Better is Merely Good</i>	1989
Susan J. Wolfe, English, <i>A Question of Semantics</i>	1990
Frank Einhellig, Biology, <i>Secrets of Plants and People</i>	1991
Larry Zimmerman, Anthropology, <i>The Past is a Foreign Country</i>	1992

Herbert T. Hoover, History, <i>Research in Historic Sioux Country: The Art of Regional Scholarship</i>	1993
Judith Lynn Sebesta, Classics, <i>Weavers of Fate: Symbolism in the Costumes of Roman Women</i>	1994
Donald C. Dahlin, Political Science, <i>On Garbage Cans, Parking Lots, and Herding Cats</i>	1995
James F. Heisinger, Biology, <i>The Evolution of Higher Education</i>	1996
Jan Berkhout, Psychology, <i>Science, Psychology, Politics, and the Liberal Arts</i>	1998
Michael P. Roche, Political Science, <i>A Pedagogy of Compassion and Hope</i>	1999
Thomas J. Gasque, English, <i>The Power of Naming</i>	2000
Cindy Struckman-Johnson, <i>Psychology, Sex, Violence, and Research</i>	2001
Leroy Nelson Meyer, Philosophy, <i>Moonlight in the Garden of Akademos</i>	2002
Dean Spader, Political Science, <i>Liberty, Equality, and Justice: "Ancient Mysteries Crying out for Understanding"</i>	Spring 2003
Lawrence Bradley, Anthropology, <i>Sticks, Stones and Broken Bones: Interpreting Traces of a Long Forgotten Past</i>	Fall 2003
Norma Wilson, English, <i>Millennium Heartbeat</i>	2004
Robert Hilderbrand, History, <i>Out of History, into History</i>	2005
Barbara Yutzenka, Psychology, <i>Reasons, Rights and Raspberries</i>	2006
Dona Davis, Anthropology, <i>Science and Serendipity: Reflections on an Anthropological Career</i>	2007

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COLLEGE OF ARTS AND SCIENCES
THE UNIVERSITY OF SOUTH DAKOTA

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