Dup. Return to Haines PD-AAM-990

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY ENTITY: DS/AGR RD-1 Type A

4. DOCUMENT REVISION NUMBER: 2

5. PROJECT NUMBER (7 digits): 931-0600

6. BUREAU/OFFICE: A. SYMBOL: DSB; B. CODE: 10

7. PROJECT TITLE (Maximum 40 characters): Mineral Studies with Ruminant Animals

8. ESTIMATED FY OF PROJECT COMPLETION: 83

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY: 81; B. QUARTER: ; C. FINAL FY: 83 (Enter 1, 2, 3, or 4)

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	300		300	900		900
GRANT	300		300	900		900
LOAN						
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY						
OTHER DONOR(S)						
TOTALS	300		300	900		900

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 81 F. GRANT	E. 1ST FY 81 G. LOAN	H. 2ND FY 82 I. GRANT	H. 2ND FY 82 J. LOAN	K. 3RD FY 83 L. GRANT	K. 3RD FY 83 M. LOAN
1) FN	111			070		300		300	
2)									
3)									
4)									
TOTALS						300		300	

A. APPROPRIATION	N. 4TH FY ___ N. GRANT	N. 4TH FY ___ O. LOAN	O. 5TH FY ___ P. GRANT	O. 5TH FY ___ Q. LOAN	LIFE OF PROJECT R. GRANT	LIFE OF PROJECT S. LOAN
1)						
2)						
3)						
4)						
TOTALS						

12. IN-DEPTH EVAL-UATION SCHEDULE: MM YY

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA BLOCK 13? IF YES, ATTACH CHANGED PID FACESHEET. 1 = NO, 2 = YES: 1

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE

TITLE

DATE SIGNED: MM DD YY

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (9-78)

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Glossary of Acronyms and Abbreviations

ALPA	Latin American Association of Animal Production Asociación Latinoamericana de Producción Animal
APHCA	Animal Production and Health Commission for Asia, Far East and South West Pacific
CATIE	Tropical Agricultural Research and Training Center Centro Agronómico Tropical de Investigación y Enseñanza, Turrialba, Costa Rica
CIAT	International Center of Tropical Agriculture Centro Internacional de Agricultura Tropical, Colombia
CONICIT	National Council for Scientific and Technological Research Consejo Nacional de Investigación Científico y Tecnológico, Costa Rica
EMBRAPA	Brazilian National Agricultural Research Corporation Empresa Brasileira de Pesquisa Agropecuaria
EPAMIG	Agricultural Research Corporation of the State of Minas Gerais Empresa de Pesquisa Agropecuaria de Minas Gerais
ICA	Colombian Agricultural Research Institute Instituto Colombiano Agropecuario, Colombia
ILCA	International Livestock Center for Africa (Addis Ababa, Ethiopia)
INCAP	Institute of Nutrition for Central America and Panama -- Guatemala
INIAP	National Institute of Agricultural Research -- Ecuador
IBTA	Technology Institute of Bolivia Instituto Boliviano de Tecnología, Bolivia
IVITA	Veterinary Institute for Tropical and High Altitude Research Instituto Veterinario de Investigaciones Tropicales y de Altura -- Peru
SODESP	Society for Livestock Development in Senegal
CSIRO	Commonwealth Scientific and Industrial Research Organization -- Australia
MARDI	Malaysian Agricultural Research and Development Institute
PCARR	Philippine Council for Agriculture and Resources Research

A. Project Summary

1. Statistical

Project Title:	Mineral Studies with Ruminant Animals in Developing Countries
New or Extension:	Extension for 3 years
Contractor:	Department of Animal Science Institute of Food and Agricultural Science University of Florida
Principal Investigators:	Dr. L. R. McDowell Dr. J. H. Conrad Dr. J. K. Loosli Dr. C. B. Ammerman Dr. R. L. Shirley Dr. H. D. Wallace Dr. J. E. Moore
Duration:	3 years, November 1980 to October 1983
Total Estimated Cost:	$900,000
Funding by Fiscal Years:	FY 81 - $300,000 FY 82 - $300,000 FY 83 - $300,000
Prior Funding:	$450,000 for current 3-year contract to expire 10/31/80
Project Manager:	Dr. J. W. Oxley, DS/AGR/L

2. Narrative Summary

In 1974, the University of Florida received a three-year contract to investigate the mineral status of grazing livestock in Latin America. The project was titled "Research in Mineral Deficiencies for Grazing Ruminants in Latin America: (AID/ta-c-1153). Contract progress was evaluated in 1976, by an external review committee, and recommendations were made to extend the program for an additional two to three years. The RAC committee concurred on this recommendation, in March 1977, and approved of a three-year extension to terminate by November 1980. An in-depth project evaluation was conducted in June 1979 to assess progress in objectives and recommend future actions. The evaluation team came to the conclusion that, "The contractor recorded commendable achievement in project objectives but the one year remaining in the contract is insufficient to satisfactorily complete all of the projected goals for Latin America and to allow for expansion into Africa and Southeast Asia." Therefore, the evaluation committee included in their recommendations that the present project be continued a minimum of two years beyond its scheduled termination of October 31, 1980.

Methods used by the contractor to accomplish objectives involved the reconnaissance of livestock raising areas and the recruitment of host country conterparts to identify conditions (Phase I), laboratory and field experimental programs (Phase II), and the distribution and application of results (Phase III). Project actions have proven that phosphorus is the most widespread mineral deficiency for grazing ruminants in cooperating countries and is more responsible than any other mineral for low reproductive rates. Copper and cobalt were also frequently deficient while molybdenum,

selenium, iodine, and flourine were sometimes present in excessive amounts (toxic). The beneficial application of this information has been emphasized via on-site mineral supplementation programs, scientific progress presented at national and international meetings, and through national institutions responsible for the training of livestock specialists and extension agents. The results of project activities should also have considerable applicability to similar ecological zones in other countries.

The reconnaissance and recruitment phase in Latin America and a few host countries in Africa and Southeast Asia are essentially completed (Phase I). The experimentation programs in Latin America are well-established and are being established in Africa and Southeast Asia (Phase II) which pinpoint mineral deficiencies and toxicities for representative areas. Phase III activities concerned with the actual application of knowledge generated by the project, have been initiated in a few situations but will need considerable more attention. This proposal for project extension is to allow for (1) the completion of basic phases now underway in participating countries, (2) the implementation of systems that insure the continual application of generated knowledge, and (3) improvement in the appreciation of the importance of proper mineral mixtures for increasing returns to livestock producers. Contract extension will also allow for extended research with additional species of ruminants.

B. Purpose and Expected Outputs

1. Purpose

The purpose of this project is to improve livestock production in the developing countries through the more efficient utilization of mineral

supplements which correct deficiencies or excesses of mineral requirements. (Success in the project will enhance the improved well being of small owners of livestock in the developing countries).

2. Expected Outputs

a. Mineral research techniques developed to assist LDCs in diagnosing and correcting mineral deficiencies and excesses in cattle, sheep, goats, water buffalo and a few camelidae family populations (Ruminants).

b. Identification of mineral deficiencies and toxicities by regions, areas, and for small atypical locations.

c. Field research programs to determine the effect of supplemental minerals on ruminant livestock performance.

d. Demonstration of the economical benefits from proper mineral supplementation and mineral products.

e. Expansion of linkages among national and international research institutions which are interested in mineral nutritional programs.

f. Dissemination of information to livestock development and research units on mineral deficiencies, toxicities and supplementation programs, and assistance to national/regional institutions in the dissemination of information and application of information by livestock owners.

g. Assistance of trained personnel to implement field and laboratory programs to diagnose mineral deficiencies and toxicities, and to take appropriate remedial action.

C. Significance and Rationale for the Research

1. Major Problem

Small farms are important units to consider in actions to lessen the

severity of hunger and poverty in developing countries. Therefore, donor countries and host agencies are expanding their efforts with this target group. A considerable number of small farmers are owners of livestock for the production of meat, milk, fiber, draft power, and for security. In developing countries, a large percentage of the livestock is ruminants receiving their entire nutrients from forages and/or poor quality roughage materials. However, these feedstuffs rarely provide all of the minerals required by grazing ruminants and there are many reports emphasizing the devastating consequences of mineral imbalances (deficiencies/excesses) on livestock production, worldwide. Minerals demanding the most attention from livestock producers because of their influence on production, reproduction, growth and survival rates are phosphorus, copper, cobalt, flourine, molybdenum, selenium, and iodine. The most economical and expeditious way of correcting mineral inbalances is through direct supplementation to the animals -- supplying the proper proportions of those minerals which are deficient or correcting for excesses. It is generally not economically feasible to correct inherent mineral imbalances of forages through crop fertilization.

2. State of the Art

Whereas dietery requirements for major and minor (trace) minerals are established in the USA, the adequacy of roughage materials for meeting dietary requirements for minerals in developing countries either is unknown or inadequately defined. Consequently, it is not possible to formulate least cost mineral supplements that meet mineral requirements in the developing countries.

The proposed project with the University of Florida is designed to assist national and regional insitutions in characterizing mineral status of local feedstuffs and related mineral content in ruminants. The project will

develop representative optimized mineral supplementation programs to correct these mineral problems.

3. - Beneficiaries

The primary beneficiary will be the small livestock owner, in the developing countries. Those who receive training under the program will increase their immediate value to the program and should realize longrange benefits as well. Due to the greater degree of worldwide coverage, information summarizations on mineral nutrition will make it possible to develop models for one region that can be useful in other regions. Primary regional activities are anticipated which will benefit entire regions over time by the diffusing of research techniques and results.

The project has been and will continue to generate technology and provide technical assistance to country programs for the development of improved management systems for ruminant livestock. Measured benefits have already been reported for ongoing and completed segments of the project. Additional benefits to the livestock producers through increased productivity are expected during the next three years and a major impact on the livestock industry is expected within ten years from the initiation of Phase III.

D. Professional Linkages

Particular attention continues to be given to coordinated/collaborative activities with international, national and regional centers. In Latin America, close contact/collaboration is maintained with CIAT, CONICIT, CATIE, and INCAP; while in Africa, similar associations have been established with ILCA and SODESP. Regional agencies in Southeast Asia, such as APHCA, are expressing interest in cooperative programs. As the program expands, other

agencies expressing interest in collaborative efforts will be assisted within the limits of the contract.

Under the current mineral research contract, cooperative research has been established by the University of Florida with the following national and international institutions: In Bolivia, the Ministry of Agriculture; in Brazil, EMBRAPA, EPAMIG, Institutions in the states of Ceara, Minas Gerais, Mato Grosso, Sao Paulo, Rio Grande do Sul, and the Amazon Cattlemen's Association; in Colombia, ICA, CIAT and Caja de Credito Agrario; in Costa Rica, the University of Costa Rica and CONICIT: in Ecuador, INIAP; in El Salvador, the Ministry of Agriculture and the University of El Salvador; in Guatemala, INCAP; in Peru, IVITA and La Molina and National University of Peru; In Uruguay, the Rubino Veterinary Research Center; in Venezuela, the Centro de Investigaciones Agronomicas, Universidad Central, Universidad de Oriente, and Universidad del Zulia. Research with these institutions will be continued with the objective of developing research methodology which will assist the developing countries in diagnosing and correcting mineral deficiencies in ruminants.

Malawi and Senegal in Africa and Indonesia, Thailand, Malayasia, and Philippines in Southeast Asia are now involved with the testing and application of the research methodology developed from activities in Latin America. These systems include representative ruminant populations of cattle, sheep, goats and water buffalo to determine mineral problems and to develop least cost mineral supplements to correct imbalances.

E. Utilization Plans

Research and survey results will contribute information to more accurately formulate nutritionally adequate and least costs mineral supplements. This

information will be disseminated through extension bulletins, publications and reports prepared by national and regional agencies, the University of Florida and in some instances through jointly prepared publications. Reports will be prepared in Spanish, Portuguese, English and/or French as appropriate.

The national and regional agencies that have collaborated with the University of Florida in this project will provide the basic organizational mechanism and trained personnel for the utilization and application of research findings from the present project and in continued monitoring/research of national mineral supplementation programs. Also, this information will be transmitted to related international centers for utilization in the development of their research programs, and in disseminating information of livestock production. It is also probable that information will be exchanged with investigators of other AID projects such as the Small Ruminant-CRSP and INFIC.

F. Management Considerations

1. Organization and Implementation

Personnel in the Animal Science Department at the University of Florida are experienced contractors and have established cooperative linkages with national and international institutions. These arrangements have proven productive. Plans are to continue cooperative research projects with national and international institutions in Bolivia, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Mexico, Peru, Trinidad, Uruguay and Venezuela.

Countries in Africa and in Southeast Asia have been selected which have significant ruminant livestock populations and whose agricultural

agency/s are interested in identifying those mineral deficiencies and excesses most limiting livestock production. Countries have selected national and/or international research institutions which, with some assistance, have the facilities and competence to determine mineral content of soil, plant and animal tissues. The more difficult analyses will be conducted at the University of Florida laboratories.

This research project is specifically designed to stimulate developing countries in mineral nutrition. Many of the developing countries already have capable scientists, highly trained technicians, and well-equipped laboratories. The success of this project depends upon finding those highly trained groups which are interested in conducting research to identify and solve mineral deficiencies and excesses which are limiting the production capacity of ruminants. The contractor will facilitate increased interest in ways which minerals can and do affect livestock production.

Steps in a successful approach have been as follows: (1) correspond with nutritionists within mineral research; (2) send them available information on mineral research techniques and samples of mineral research projects which are in progress in other countries; (3) visit them in person and discuss in detail their interest, those factors most limiting their mineral research program and those elements which the AID-sponsored mineral research program might contribute; (4) assist them in developing a mineral research program in which they are interested and which can reasonably be completed under their conditions with limited assistance from this mineral research project.

In the current contract, the specific contributions of Latin American institutions compared to AID/Florida inputs have been estimated to be between 15 and 20:1. The AID/Florida project conducts difficult analyses

and contributes professional expertise for design, implementation, and conduct of research as well as the interpretation of research data and assistance with reporting research results. This proposed project extension will also furnish funds for chemicals that are difficult to obtain, laboratory supplies and expendable supplies for the collection, preservation, and analysis of samples.

2. Sole-Source Procurement

This will be a sole-source procurement contract, since the project will be an extension of ongoing activities, and since the present contractor not only has demonstrated institutional compentence to execute this project, but also has predominant capability in mineral nutrition in developing countries.

3. Project Evaluation

The project will be evaluated in detail by an external evaluation team during the second year of this contract extension. This evaluation will be conducted by an on-site visit composed of qualified outside consultants and will include at least one representative of a developing country of Africa, Southeast Asia or Latin America. The Development Support Bureau (DSB) will sponsor the evaluation team and determine the member composition. The evaluation will be conducted according to established guidelines and policies of DSB/AID.

G. Project Background Description

1. General Background

Chemical analyses of feedstuffs gathered under the University of Florida Latin American Feed Composition Project (AID/csd-2498) revealed that tropical

forages are severely deficient in several essential mineral elements. Forages rarely provide all the minerals required for ruminants.

In November 1974, the University of Florida entered into a contract entitled "Research in Mineral Deficiencies for Grazing Ruminants in Latin America" AID/ta-c-1153. Phosphorus is the most widespread mineral deficiency for ruminants consuming tropical forages and is more responsible than any other mineral for low reproductive rates. In addition to phosphorus, cobalt and copper are likely to be deficient for ruminants in the tropics. Phosphorus values in 48% of 1129 forage samples were found to be 0.2 percent or less as reported in the Latin American Tables of Feed Composition (McDowell, Conrad, Thomas, and Harris, 1974). Phosphorus deficiency has been reported in 35 developing countries (McDowell, 1976), which include the major ruminant livestock producing countries of Africa, Asia, and Latin America.

The most devastating consequence of phosphorus deficiency throughout the tropical world is reproductive failure. Phosphorus deficiency produces a marked inhibition of the estrus cycle. Under conditions of extreme phosphorus deficiency, cattle may go for two or three years without producing a calf or even coming into estrus (Phillips, 1956; Raun, 1975). In phosphorus deficient areas, cows may not come into a regular estrus after calving until body phosphorus levels are restored either by feeding supplementary phosphorus or by cessation of lactation.

Phosphorus supplementation has dramatically increased fertility levels in grazing cattle in many parts of the world. In two year ovservations of 200 South African cattle, calf crops increased from 51 percent in control cattle to 80 percent for phosphorus supplemented cattle (Theiler, Gree and du Toit, 1928). Phosphorus supplementation studies in south Texas resulted

in a weaning calf crop of 81 percent as compared to 58 percent for the control (Black, Tash, Jones, and Kelberg, 1943). In Brazil, phosphorus supplementation resulted in a 77 percent calf crop as compared to 55 percent for the controls, (Conrad and Mendes, 1965). In the Colombian llanos, phosphorus supplementation resulted in an 85 percent pregnancy rate compared to 50 percent for the controls, (Stonaker et al, 1975).

Phosphorus is also the most expensive mineral ingredient to purchase. Limited results show that phosphorus supplementation is most beneficial during the season of maximum forage growth. However, during the dry season, protein and energy are often the first limiting factors. Information on the effects of the frequency of supplementation and the mineral carryover with intermittent supplementation are not available. This information is necessary so that recommendations can include the most economical system for feeding phosphorus and considerations of situations when prices are high and supplies are limited.

Cobalt, copper, selenium, and zinc are the microminerals most likely to be deficient for ruminants in developing countries. These deficiencies are largely restricted to ruminants which have little or no access to supplementary feeds. Nineteen developing countries or regions have reported cobalt deficiencies while copper deficiencies have been reported in 17 developing countries. Copper deficiencies in cattle, as with cobalt, occur mainly under grazing conditions with gross sysptoms of the deficiency rare when concentrates are fed. Deficiencies of copper can be either simple, due to a lack of copper, or induced by excess intakes of sulfur and/or molybdenum. Chronic copper toxicity is almost entirely confined to sheep which indicates species differences in tolerances to excesses. Recent research under this

project indicates widespread sele..um and zinc deficiencies which must be more specifically identified during future project activities.

Clinical signs of molybdenum toxicity are similar to copper deficiency. An excessive intake of molybdenum will seriously deplete copper reserves in cattle quickly leading to scouring, loss of condition, and other signs associated with copper deficiency. Molybdenum toxic areas characteristically occur on poorly drained neutral or alkaline soils which favor molybdenum uptake by plants and reduce the availability of copper. Both molybdenum toxicity and copper deficiency are corrected by providing additional copper to the animals' diet.

2. Findings and Accomplishments to Date

Research is continuing to be conducted and application methodology is being developed to correct problems of mineral deficiencies and/or excesses. Deficiencies of phosphorus, cobalt, copper, selenium, and zinc are common in specific regions of Latin America, Asia, and Africa. Toxicities of molybdenum, selenium, and fluorine also have been receiving attention in some of these countries. Host country institutes have been enthusiastic participants in all phases of the research and application programs and have been larger contributors than the contractors (sponsored by AID).

Details of individual mineral research projects and of country activities have been compiled in an Annual Report, by the University of Florida. The report covers the period from March 1, 1978 to June 1, 1979 and also includes other aspects of the contract AID-ta-c-1153 within its 267 pages. This report includes:

a. Lists of literature reviews undertaken.

b. Citings of working relationships with technicians in LDCs.

c. Establishment of linkages with other AID activities.

d. Collaboration with national and international institutions.

e. Results of mineral experiments in specific areas.

f. Application of experimental results to field locations.

g. Program inputs by the contractor, host country and AID.

h. Dissemination of information via seminars and symposia.

i. Project related publications produced by the contractor.

j. Reports presented at national and international meetings.

k. Graduate training provided to eight developing country scientists.

H. Project Work Plan

Scope of Work (Nov. 1, 1980-Oct 31, 1981)

In the extended contract period, the contractor must continue to emphasize collaboration with national and/or international institutes in each of the cooperating host countries of Latin America, Asia, and Africa. Each of the projects will receive guidance from one or more of the senior scientists on the contractor's staff in collaboration with representation of host institutions, agencies, etc. Some of the most important items for attention during the first year have been identified and are set forth. Annual work plans for the second and third years of the project will be forwarded to the project manager before these contract years commence.

A. The project will continue determinations of the mineral content of soil, plant and animal tissues from areas in 11 Latin American, 4 Asian and 2 African countries where ruminant animals are of major importance. Both major and minor essential minerals will be studied (Ca, P, Mm, Mg, Cu, Co, Zn). Graduate students will be utilized on studies in their home territories, when appropriate. This will insure a reliable source for information, contribution of a personal interest ingredient, contributions from a host country and serve as a tool for training purposes. In addition, members of the University of Florida, Soils and Agronomy Departments will be consulted on special soil-plant-animal relationship abonormalities. The contractor will continue to identify host country counterparts parts in technical and administrative capacities who are responsible for daily, routine supervision and can alert the contractor on emergency situations.

1. Some of these trainees will be taught how to suspect mineral problems in livestock units via observations on production rates as well as abnormal appearances of plants, etc. Indicator plants will also receive attention and be identified.

2. The trainees will be learning how to obtain and process reliable samples of biological materials for mineral content. This means the reliable collection of soil, plant and animal samples that will accurately predict the true mineral status of the population or region. Samples from animals may include blood, liver, kidney, fat, hair etc. Most of these can be obtained from the live animals as well as carcasses. The techniques for properly obtaining such samples are extremely important as they can influence the results from analyses. Manuals describing these techniques are available for further distribution by the contractor.

3. Technicians will be trained to handle samples during analyses and to interpret the results of the analyses. Depending upon the situation, some of the laboratory technicians will be trained to perform one or two procedures such as grinding and weighing samples while others will be trained to completely analyze samples - up to the limit of the particular laboratory (this will include a proximate analysis in most cases plus some mineral analyses) .

The contractor will encourage the latter type of training so that the better trainees will eventually become trainers of future technicians.

4. The leadership abilities of animal scientists and graduate students from host countries will be strengthened by improving their capabilities in mineral orientated activities. This will increase their respect with fellow agriculturists.

Contract representatives will continue to make certain that host country scientists know about special international meeting and are supplied with reports on the latest developments in mineral findings world wide. This will strengthen the foundation knowledge for extension oriented activities where generated information will be prepared for presentation at field days, in radio talks, at seminars and during rap sessions.

C. The identification, development, and continued proper functioning of the analytical laboratories needs constant attention by the contractor. The newly established laboratories must be conveniently located for reasonable assessability to serve the important livestock growing regions. The contractors goal is to have at least a good functioning laboratory in each host country.

1. The host agency and the contractor will procure essential reliable laboratory equipment for the laboratories involved in the program. The host agency will purchase most of the equipment but the contractor will assist with equipment specifications, laboratory organizations and installation problems. Malawi and Senegal should receive considerable attention in this aspect.

2. The contractor has in the past and will continue to assist developing countries during laboratory breakdowns, equipment irregularities, the translation of operating instructions, orientation of new operators and in solving short term deficiencies in expendibles, chemicals, and glass ware. These situations cannot be scheduled but are anticipated through the life of the contract.

3. The training of the laboratory workers was included in the section on overall training to be provided and continued.

D. The scheduling of travel, by the contractor, will continue to be coordinated by the project leaders to insure efficient use of time and resources of both the contract representatives and the scientists in the host countries. Therefore, a tentative schedule is proposed which will be adjusted to fit alterations in presently projected schedules, as the year progresses.

1. The purpose of the host country visits will be to a) expand the identification of competent collaboration for managing future studies and for training b) locate additional regions with livestock owners who have mineral problems affecting livestock production to refine area parameters, c) to encourage the sponshorship of research trials and recommend experimental designs for implementation by local livestock visits d) and to collect or advise the collaborator in the analyses of experimental data and interpretation of results for dissemination.

2. A proposed schedule of travel and purposes of travel for the first extension year is as follows:

November-December (2 wks.) - Peru, Bolivia

Peru- The institutions visited will include:

a. Universidad Nacional Mayor de San Marcos (IVITA) - Lima

b. Universidad Nacional Agraria (La Molina) - Lima.

C. Universidad Nacional Pedro Ruiz Gallo - Lambayeque.

Each of these institutions has an active mineral supplementation program. IVITA and La Molina are involved with research with small ruminants (sheep and llamas) in addition to cattle. The Universidad Nacional Pedro Ruiz Gallo is currently expanding research into the northern states of Peru.

Bolivia - a. Instituto Boliviano de Tecnología (IBTA) - La Paz.
b. Centro de Investigación Agrícola Tropical (CIAT) and the Facultad de Veterinaria y Zootecnia - Santa Cruz.
c. Private ranch - Beni.

Work with IBTA and in Santa Cruz involves M.S. degree programs. There are presently 2 Bolivian students enrolled at Florida in the mineral research area. One student will be returning to Bolivia for additional sample collections during the one-year extension. The final year of a 3-year mineral supplementation trial involving 1800 cattle will be completed during the first year of the extension.

January - February, 1981 (4-6 weeks) - Malawi and Senegal

Malawi - a. Bunda College of Agriculture, University of Malawi
b. Department of Agricultural Research, Ministry of Agricultural and Natural Resources

One Ph.D. student from Malawi currently enrolled at the University of Florida will return to Malawi to collect soil, plant and animal tissues at 10 locations in three regions for analyses at the Nutrition Laboratory, U.F. The first set of samples were collected in August - September, 1979, at the end of the dry season, the second set will be collected during the rainy season.

Senegal - a. SODESP, Society for Livestock Development in Senegal, Ministry of Agriculture and USAID.

This trip will be made by one University of Florida faculty member to assist in collecting animal tissue samples from small ruminants in the northern pastoral zone of Senegal.

February (2-3 wks.) - Costa Rica, Panama and possibly Mexico.

Costa Rica - a. Animal Science Dept. Universidad de Costa Rica - San José.

Costa Rica has had the most active research program of all LDC's. Phase 1, which included the mapping of various areas of Costa Rica in relation to mineral deficiencies and toxicities, has been completed. Phase 2, involving mineral supplementation trials, is now in progress.

Panama - a. Instituto de Investigación Agropecuaria de Panama (IDIAP) - Panama City.

Starting in September of 1981, a Ph.D. student from Panama will be enrolled in the Animal Science Department in the area of mineral nutrition. For his thesis, he will be returning to Panama for the purpose of evaluating the mineral status of various regions of Panama. This will be the first visit to Panama in relation to mineral research and the possibility of a collaborative program.

Mexico - Interest has been expressed by a number of individuals from various institutions for going ahead with mineral research. The possibility exists that a trip and/or workshop related to mineral research programs would be held in Mexico City.

April - May 1981 - Philippines, Thailand, Malaysia, Indonesia and Australia.

This trip will be made by two Florida staff members. This will only be the fourth visit to Asian countries which recently became involved in mineral research programs. (3½ wk. trip).

Philippines - a. University of the Philippines - Los Baños.
b. Philippines Council for Agriculture and Resources Research (PCARR) - Los Baños.

The mineral research program in the Philippines is the most active in Asia, as many samples are now being analyzed and supplementation trials are being established in various parts of the country. Research in mineral nutrition is being carried out by students in obtaining advanced degrees.

Thailand - a. Kasetsart University - Bangkok.

This will only be the third visit to Thailand. The comprehensive mineral research program in Thailand has only begun. Two supplementation trials have been completed which demonstrated the benefits of mineral salts. Still more supplementation trials are needed and emphasis needs to be placed on increasing the capabilities for mineral analyses at Kasetsart's laboratory.

Malaysia - a. Universiti Pertanian Malaysia - Serdang.

Laboratory analyses have already begun; however, there are problems with existing procedures. One supplementation trial has been completed and another one is just beginning which will last for several years.

Indonesia - a. Gadjah Mada University - Jogyakarta.
b. National Atomic Energy Agency - Jakarta.

Only a limited amount of mineral research has been completed. Mineral supplementation trials have been planned but will not begin for several months.

Australia - The purpose of visiting will be to make presentations at the World Mineral Nutrition Conference.

July 1981 - The American Society of Animal Science will be attended. Between 6 and 8 abstracts will be presented in the area of mineral nutrition by various foreign graduate students.

July - August, 1981 (4 weeks) - Brazil and Uruguay

Brazil - Beef Cattle Research Center, Campo Grande, EMBRAPA
Small Ruminant (Goat) Research Center, Sobral, Ceará, EMBRAPA
Biological Institute, São Paulo
Brazilian Society of Animal Science

This trip will be made by one Florida faculty member. The mineral research program in Brazil has reached the advanced stage where only one trip per year is required to advise on mineral research programs and present papers at the annual Brazilian Society of Animal Science meetings. One Brazilian with a Ph.D. in mineral nutrition from Florida is currently in charge of mineral nutrition research in Brazil.

Uruguay - Rubino Veterinary Research Center

One two-week visit will be made as part of the Brazil trip. One faculty member at the Rubino Veterinary Research Center is in charge of the mineral research program in Uruguay. One trip per year is necessary to assist with experimental design, evaluation of results and to advise on technical details.

September - October 1981 (2½ wks.) - Colombia, Venezuela and the Dominican Republic

Colombia - a. Instituto Colombiano Agropecuaria (ICA) - Bogotá.

ICA has been responsible for very large mineral research programs which contain components of both mapping research and mineral supplementation. The purpose of the visit will be to help with the intrepretation of mineral data and to make plans for future research. More emphasis needs to be place on research in the large llanos region of Colombia.

Venezuela - a. Universidad de Zulia - Maracaibo.
b. Centro de Investigaciones Agronómicas - Maracay.
c. Universidad del Oriente - Jusepín.

These three insitutitons are actively involved in mineral research. There are currently three Venezuelan students at Florida working in the mineral nutrition area. Another student will enter the University in September 1981 for a Ph.D. degree in this area. A large number of samples have been collected from the llanos region of Venezuela; however, much more research is needed. The main contact at the Universidad del Oriente has done a tremendous amount of analyses and now time is required for publishing this data in the scientific and extension literature.

Dominican Republic - a. Secretaría de Estado de Agricultura - Santo Domingo
b. FAD - CESDA - Santo Domingo.

In June, 1980, a visit was made to the Dominican Republic to establish a mineral research program. An M.S. degree student has collected samples from various ranches throughout the country to evaluate mineral status. This will be a follow-up visit to determine the status of the newly established program, and to attend and make presentations of mineral data at the 1981 Latin American Animal Science Convention (ALPA).

E. The contractor will continue to provide professional assistance in the development and printing of popular, scientific and journal publications.

1. Reports and circulars will be used in short courses, field days, seminars and as extension materials. Several of these publications should surface in host countries to illustrate the value of minerals or on information already generated from active research projects in adjacent areas.

2. A few scientific reports and articles will also be prepared for professional meetings and journals, with assistance from the contractor. Previous achievements in this area are presented in the appendix of this document to show quantity of publications generated by contractor activities.

3. The contractor will continue to be responsible for the revision of laboratory methods manuals in local languages. Editions already available in English, Spanish and Portuguese have been widely used and known to be valuable tools for developing country scientists. An edition in French and one for Asia are to be drafted and distributed. These publications will be translated into local language through sub-contracts with native translators.

2. Time Phase for Activities (November 1974-October 1983)

	Starting Dates		Expected
	Initial	Extension	Completion
A. Preliminary Development of Mineral Research Programs	Nov 74	Nov 80	Oct 83
1. Literature review of mineral research results	Nov 74	Nov 80	Oct 82
2. Contacting and recruiting research personnel in participating countries	Nov 74	Nov 80	Jan 81
3. Development of laboratories for mineral analysis	Dec 74	Nov 80	Jan 82
4. Standardization of sample collection, analysis and data reporting	Mar 75	Nov 80	Oct 83
B. Conduct experiments to counteract molybdenum and selenium toxicity	Jul 76	—	Jul 78
1. Selection of research sites	Jul 76	—	Jul 78
2. Collection and analysis of samples	Jul 76	—	Jul 78
3. Interpretation of data	Jul 76	—	Jul 78
C. Improve capacities of cooperating institutions	Dec 77	Nov 80	83
1. Collaborating personnel receive training at Florida and in participating country.	Sep 78	Nov 80	Oct 83
D. Conduct mineral supplementation experiments	Dec 77	Nov 80	Oct 83
1. Selection of mineral research sites	Dec 77	Nov 80	Oct 82

2. Collection and analysis of samples	Mar 78	Nov 80	Oct 83
3. Interpretation of data	Nov 78	Nov 80	Oct 83
E. Determine the effect of periodic phosphorus and mineral supplementation	Dec 78	Nov 80	Oct 83
1. Selection of mineral research sites	Dec 77	Nov 80	Oct 83
2. Collection and analysis of samples	Mar 78	Nov 80	Oct 83
3. Interpretation of data	Jul 79	Nov 80	Oct 83
F. Generate/compile data for formulation of adequate mineral supplements	Nov 74	Nov 80	Oct 83
1. Collection and analysis of tissue samples	Nov 74	Nov 80	Oct 83
2. Carry out mineral supplementation trials	Jul 75	Nov 80	Oct 83
3. Advise on formulation and use of adequate mineral supplements	Nov 74	Nov 80	Oct 83
G. Evaluation of commercial mineral supplements	Nov 74	Nov 80	Oct 83
1. Collection and analysis of mineral samples	May 75	Nov 80	Oct 83
H. Determine the cost/benefit ratios from use of minerals	Dec 78	Nov 80	Oct 83
I. Publication of research information	Jul 76	Nov 80	Oct 83
1. Statistical analysis and interpretation of research data	Jul 76	Nov 80	Oct 83
2. Development of producer oriented extension bulletins on minerals	Jul 76	Nov 80	Oct 83
3. Articles for scientific publications	Dec 76	Nov 80	Oct 83
4. Reports at professional meetings	Sep 76	Nov 80	Oct 83

Test mineral research methodology in Africa and Asia	Dec 77	Nov 80	Oct 83
1. Selection of mineral research sites in Africa and Southeast Asia	Dec 77	Nov 80	Oct 82
2. Collection and analysis of soil, plan and animal tissue samples	Jul 78	Nov 80	Oct 83
3. Correlate mineral levels among ruminant populations	Jul 79	Nov 8	Oct 83

3. End of Project Status

a. Mineral deficiencies, adequacies, and excesses will have been identified in selected areas of developing countries where ruminants predominate.

b. Mineral research methodology will have been tested in a few countries of Africa and Southeast Asia on representative ruminant populations (cattle, sheep, goats, cameloids and water buffalo) and the information derived will provide the basis for supplementation programs to correct mineral deficiencies.

c. Soil-plant-animal mineral relationships will have been tested for diagnosing the mineral status of ruminants.

d. The cost/benefit rations will have been estimated on the use of supplemental phosphorus and other minerals which affect animal and herd productivity.

e. Research will have been conducted to determine the validity of different mehtodologies for establishing mineral status of ruminant animals.

f. The capacities of cooperating institutions to carry out mineral research will have been improved.

g. Well-controlled experiments will have been completed to determine the effect of mineral supplementation on growth and reproductive performance and on mortality.

h. The effect of phosphorus supplementation during the rainy season and the carryover effect into the dry season will have been studied.

i. Field trials have been conducted to study methods to counteract molybdenum and selenium excesses.

j. Data will have been generated and used to design adequate mineral supplements for different regions.

k. A more systematic approach will have been developed for standardizing sample collection, analyses, and data reporting.

l. Research information designed to stimulate the widespread use of mineral supplements will have been published and distributed.

m. Evaluations of commercial mineral supplements will have encouraged companies, researchers, and ranchers to formulate, produce, and use high quality and nutritionally adequate mineral supplements.

n. Producer oriented extension bulletins will have been published on mineral deficiencies and excesses for grazing ruminants (in Spanish, Portuguese, English and French).

I. Researchers Competence

The Department of Animal Science, Institute of Food and Agricultural Sciences (IFAS) at the University of Florida has established itself as one of the leading departments working in the field of tropical animal science.

Biodata for each of the seven principal investigators can be found in the appendix. All have been involved in the current mineral research project and expect to be associated with its progress.

J. Contributions to Institution Building

All phases of the project will seek close cooperation with indigenous and international research organization. No research will be undertaken independent of the indigenous research organizations. The vast majority of all mineral analyses will be performed in the collaborating countries where individuals and facilities have been identified for doing mineral research.

The institutions which are cooperating in mineral research will benefit

in several ways. First, they will obtain analytical data illustrating specific areas of their countries where mineral deficiencies and/or excesses exist. Second, they will obtain information based on feeding trials as to the proper mineral supplements needed for ruminants. Third, the economic benefits of mineral supplementation will be clearly established. Fourth, the cooperating research units will have the knowledge and experience to continue research in minerals for livestock after the contractor departs. And finally, the established operating institutions will have the potential to assist in the development of additional livestock mineral projects which cover country-wide livestock activities.

K. Probable Benefits for the Livestock Producer

Improvement in the levels and balances of minerals in livestock will increase productivity including such items as mortality, growth rates, feed efficiency, fertility, reproduction, milk, fiber, and work. An increase in production will result in a greater monetary income (saleable items) for the small livestock producer or an increase in animal products for personal consumption (meat, milk, etc.).

An increase in animal productivity will result in benefits to the farm family, from both increased income and consumable products. These benefits of additional cash and animal products, resulting from greater productivity, will improve the well being (education, medical attention, nutrition and sanitation) of the livestock raisers family. In addition, improvements in animal productivity could take less animals to equal former production amounts. This would result in more efficient utilization and/or conservation of natural resources (native rangelands) and more efficient utilization of family labor.

This project will provide the methodologies by which LDCs and their agencies can implement efficient mineral supplementation programs with the low income livestock producers. As these programs progress, a spreading of technology will be duplicated from farmer to farmer, area to area, etc. This program can serve as a model for future thrusts into animal health and livestock management areas. National services will be strengthened by contract actions to implement practical programs for promoting economically beneficial practices, in the entire livestock production field. The successful termination point will be the establishment of effective regional programs by original host government agencies.

L-Women in Development

Women occupy key positions in agriculturally-oriented households. Often, women own livestock and are completely responsible for the processing of livestock products which are either sent to market or consumed directly by the family (meat, milk and fiber). In many countries, women or young girls also tend the flocks, feed, and care for the animals as a portion of the household income-earning activities. Therefore, many of the intended beneficaries of this program will be the female household members who are deeply involved with livestock systems. As some societies in developing countries place restrictions on non-family male/female contacts, it is imperative that females be thoroughly trained as livestock production agents for effective promotional purposes. Opportunities for female extensionists and technicians of developing countries to attend workshops, field days, short courses and other educational sessions, should be developed, based on local custom, so that the materials presented in these sessions will reach female members of the target population.

The current research contract (AID 931-0600) has employed women scientists in the Animal Nutrition Laboratory of the University of Florida and as laboratory and/or scientific professionals in many developing countries. Women from developing countries also have been awarded scholarships for graduate training in project related activities and this action will be

continued. Trained women animal scientists must assume leadership roles in program activities within the developing countries and these individuals must include both U.S. and host country citizens.

M. Environmental Considerations

Activities of this project should not cause any detrimental effects to local environments and should tend to encourage preservation of natural resources.

N. External Evaluation

The external evaluation team report is attached (Appendix #1) which supports an extension of this project. Their recommendations were taken into consideration in the preparation of this proposal, and are in agreement with the proposal as presented.

The reviewers are preeminent livestock production specialists and researchers. Dr. Glenn Beck, Chairman of the review team and former Vice President of Kansas State University has had extensive domestic and international experience in livestock production research and as an administrator. Dr. Duane Ullrey, Professor of Animal Nutrition, Michigan State University, has held important posts in industry and in the university system. Dr. Juan Salazar of VECOL, Empresa Colombiana de Productos Veterinarios, Bogata, Colombia, was selected for the team to assist with observations and recommendations from a person representing the recipient countries. Dr. Salazar has the D.V.M. degree and the M.S. and Ph.D. degrees in animal breeding. He has occupied research and administrative positions with the Instituto Colombian Agropecuaro (ICA) and Caja de Credito Agrario. Mr. Boyd Whittle, of USAID,

the fourth member of the review team has had numerous years of experience in Latin America with A.I.D. agricultural programs and was formerly a livestock extension specialist with the University of Maryland. Mr. Whittle is presently a member of the A.I.D. Africa Bureau.

The project progress will be reviewed annually by the project manager and an external evaluation team will conduct a review at the end of the second year of the new contract. The external evaluation team will be made up of eminent livestock production specialists.

O. Past Contract Appraisal

Accomplishments during the present contract have been generally up to expectations. However, mineral supplementation trials are not as far along as anticipated. Activities during the third year (FY80) of the present contract will concentrate on the realization of a limited number of trials to determine response to mineral supplementation, and on providing technical assistance to national institutions in establishing their mineral supplementation programs.

This project is of high priority. An extension is needed to enable completion of the present project in Latin America and to expand the project in Africa and Southeast Asia. The extension should (a) continue to demonstrate the solving of nutritional problems which are depressing animal production, (2) continue demonstration on cost/benefit ratios derived from the use of correct mineral supplements, (3) broaden the emphasis on proper identification of mineral deficiencies and/or excesses, and (4) assist in the expansion of host country sponsored nutritional research projects to include sheep, goats, llamas, alpacas, cattle, and water buffalo. The present proposal for extension is sound, and cost estimates are commensurate

with proposed work programs.

In order to achieve the original project objectives and to make maximum utilization of technology and expertise development in this project, we strongly recommend that funding be provided at the level suggested to extend this program for three more years.

P. Financial Aspects

1. AID Contract Costs for Three-Year Extension

A budget, showing estimated dollar costs for line items, for each of the three years is presented. Although the total amount is the same for each year, amounts for certain line items vary from year to year to reflect increases in salaries, transportation, etc., and in reduction in the purchase of laboratory equipment, costs for outside laboratory services, etc. These estimates reflect increased costs for expanding the mineral research to Southeast Asia and Africa which increases transportation and per diem costs. Allowances have been inserted to assist in offsetting inflationary effects.

Overhead has been calculated at 44.4 percent on the parts of the budget in accordance with the U.S. Office of Management and Budget (OMB) rather than salaries as in the past. Although the overhead as a percentage of the total budget has increased, it does conform to both the University of Florida and OMB's latest mandates.

COST PROPOSAL FOR MINERAL STUDIES WITH RUMINANT ANIMALS (US $)

Contract Period	11/1/80 10/31/81	11/1/81 10/31/82	11/1/82 10/31/83	11/1/80 10/31/83
Line Item	**FY 81**	**FY 82**	**FY 83**	**TOTAL**
Salaries (24 person mo/yr)	60,000	65,000	70,000	195,000
Consultant (15 person days/yr)	2,000	2,500	3,000	7,500
Fringe Benefits	12,000	13,000	14,000	39,000
Training & assistantships (18 person month & 12 person month/yr)	10,000	12,000	14,000	36,000
Overhead (44.4% of contract to conform with OMB)	129,000	129,000	129,000	387,000
Travel & Transportation (U.S. & International)	17,500	18,000	18,500	54,000
Allowance Per diem	5,500	6,000	6,500	18,000
Other Direct Costs				
Contingencies (1.5%)	4,000	4,000	4,000	12,000
Inflation (10%)	25,000	25,000	25,000	75,000
Equipment, Material & Supplies	35,000	25,500	16,000	76,500
TOTAL	300,000	300,000	300,000	900,000

2. Consultant Fees

One or two consultants who are not University of Florida faculty may be used on a limited short-term basis so some money will be needed for consultants.

3. Equipment

Several pieces of laboratory equipment must be purchased, shipped and installed for basic laboratory procedures. The contract will assist the host institutions in procurement of such items but only on a partial support basis. Similar support will be provided through the contractor when essential equipment is disabled. The host institutions will have to assume the major obligations in the purchase and receiving of all equipment used in the project.

4. Laboratory and Field Supplies

Would include the following: plastic sample collecting bottles, needles, syringes, atomic absorption lamps (Co, Cu, Mn, Ca, Mg, Zn, Fe, Mo, and Se), dry ice, gas cylinders (nitrous oxide, acetylene/argon), trace mineral supplements, calcium and phosphorus supplements, porcelain crucibles, volumetric flasks, graduated cylinders, funnels, funnel supports, centrifuge tubes, wide-mouth bottles, test tube supports, procelain spatulas, test tubes beakers, volumetric pipettes, measuring pipettes, separatory funnels, cuvettes, pipette jars, pipette rinsers, falcon test tubes, stirring rods, wash bottles, Nalgene bottles, polypropylene funnels, ceramic marking ink, wax marking pencils, vinyl tape, filter paper, mineral standards, trichloracetic acid, ammonium molybdate, HCl, H_2SO_4, HNO_3, potassium dichromate, NaCl, KCL, dessicant, formaldehyde, lithium citrate, crucible tongs, and office supplies. The majority of the above items will be consumed in the proposed research and will need to be periodically replaced. Possible exceptions will include some of the glassware.

5. Estimated Travel Per Year of the Contract

Country	Number Visits/Yr	Number Persons	Total Scientist Days
Africa			
(Senegal, Malawi Sudan and Zaire)	2	1	42
Asia			
Indonesia	1	2	10
Philippines	1	2	12
Malaysia	1	2	10
Thailand	1	2	10
Latin America			
Bolivia	2	1	14
Brazil	1	1	21
Colombia	2	1	10
Costa Rica	1	1	3
Dominican Republic	2	1	10
Ecuador	1	1	7
Guatemala	1	1	4
Peru	1	1	7
Uruguay	1	1	7
Venezuela	1	1	7
Other Possible Countries (Mexico, El Salvador and Surinam)	1	2	12

The purpose of the trips are to:

1. Discuss proposed research with appropriate administrative and research personnel in each country.

2. Assist in the establishment of procedures and methods concerning experimental design, sample collection and laboratory analyses.

3. Assist in the design and initiation of feeding trials.

4. Evaluate the progress of the mineral research which is currently underway in the participating countries.

5. Initiate other mineral research as problems surface and test research methodology.

AID 1030-23 (3-78)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 1981 to FY 1983
Total U.S. Funding 900,000
Date Prepared: 4/27/81

Project Title & Number: Mineral Studies with Ruminant Animals in Developing Countries

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To efficiently increase productivity of all ruminants in the developing countries.	**Measures of Goal Achievement:** Increased reproduction and growth rate of ruminants in the developing countries of Latin America, Southeast Asia, and Africa.	Comparative productivity with and without mineral supplementation. 1. Variation in Milk Production 2. Variation in growth rates. 3. Variation in meat yield/animal. 4. Variations in reproductive rates.	**Assumptions for achieving goal targets:** 1. Mineral supplements are available. 2. Efficient mineral supplementation regimes are developed. 3. Mineral supplementation programs are implemented. 4. Forages are deficient or contain excesses of certain minerals.
Project Purpose: To determine the mineral status of ruminants in developing countries and to develop efficient mineral supplementation regimes for ruminants.	**Conditions that will indicate purpose has been achieved: End of project status.** Cooperating countries will have initiated programs to provide/promote use of efficient supplements/supplementation regimes to correct the mineral deficiencies in livestock production.	Viable mineral supplementation programs in collaborating countries.	**Assumptions for achieving purpose:** 1. Outputs as specified are achieved. 2. Mineral supplements are available. 3. Favorable cost/benefit ratios exist for mineral supplementation. 4. Mineral supplementation programs are implemented.
Outputs: 1. Identification of mineral deficiencies and toxicities (excesses). 2. Determine response to mineral supplementation. 3. Determine economics of mineral supplementation. 4. Establish linkages with Nat'l and international institutions. 5. Develop mineral research methodology. 6. Formulate most economical mineral supplements. 7. Preparation of publications on mineral nutrition. 8. Training of project personnel.	**Magnitude of Outputs:** 1. Collect information in cooperating countries. 2. Conduct supplementation trials in 16 countries. 3. Prepare comprehensive report on economics. 4. Linkages established with National institutions plus international centers. 5. Development of mineral research methodology. 6. Formulation of representative mineral supplements. 7. Preparation & dissemination of	**Magnitude of Outputs (Continued)** of publications on mineral nutrition programs, research methodology, scientific papers. 8. Trained personnel in each national institution.	**Assumptions for achieving outputs:** 1. Collaborating countries/agencies have the organizational structure and project leadership to achieve country outputs. 2. University of Florida identified professional and support staff to achieve stated outputs.
Inputs: 1. Analytical laboratories in developing countries with laboratory and field personnel. 2. University of Florida nutrition laboratory and personnel support. 3. AID funding and project management.	**Implementation Target (Type & Quantity):** 1. Developing Countries: (a) At least one functional analytical laboratory in each collaborating country.	**Implementation Target (Continued)** (b) Laboratory personnel to man their laboratories. (c) Field personnel to collect information on mineral status of soil, plants and animals; 2. University of Florida (a) Analytical Laboratory & personnel including research assistants. (b) Project personnel. 3. AID - (a) budget 300,000/yr; (b) one project manager.	**Assumptions for providing inputs:** 1. Funding is available to collaborating countries/agencies to provide prescribed inputs. 2. AID funding for three years to provide prescribed inputs.

R - Appendix

1 - Evaluation Team Report	6 pages
2 - Bio data for PI/s	16 pages
3 - Publications from Project Activities	12 pages

DEVELOPMENT OF EFFICIENT MINERAL SUPPLEMENTATION REGIMES FOR GRAZING RUMINANTS IN THE TROPICS

REPORT

Team Evaluation of DS/AGR Project 931-0600

June 1979

Team Members

Dr. Glenn Beck, Kansas State University
Dr. Juan Salazar, VECOL, Empresa Colombiana de Productos Veterinarios, Colombia
Dr. Duane Ullrey, Michigan State University
Mr. Boyd Whittle, AID African Bureau

PROJECT BACKGROUND

History of the Project The Florida Mineral Project No. 931-0600, supported under AID contract, AID/ta-c-1153, was started in November, 1974. The project was reviewed in November, 1976 by an external evaluation team. Following this review, AID extended the project an additional two years. It is funded until November, 1980, at which time it will terminate unless further extended.

Definition of the Problem Mineral deficiencies occur in most tropical and semi-tropical regions of the world. Grazing ruminants are generally less productive in these areas than in the more temperate climates. Low productivity is associated with disease, low planes of nutrition, climatic stress and malnutrition resulting from mineral deficiences or imbalances. Mineral deficiencies result in low reproductive performance, high mortality, slow growth rates and low production (milk, wool, etc.).

Objectives of the Project The primary objective of this project is to determine the essential mineral supplements for grazing animal diets to increase efficiency of meat and milk production systems with a resultant increase in quality and quantity of food in LDCs and a subsequent increase in employment and income levels. The specific objectives are as follows:

1. To experimentally determine the locations of mineral deficiencies, adequacies, and toxicities in selected areas of Latin America;

2. To establish the biological response and the economic benefit of mineral supplementation of grazing animals;

3. To evaluate methods of mineral supplement administration for grazing cattle;

4. To publish and distribute research information to stimulate wide spread use of mineral supplements for grazing ruminants.

MAJOR ACCOMPLISHMENTS OF THE PROJECT

The review team evaluated the overall progress made in the Florida Mineral Project since it was started in 1974, but gave special attention to the accomplishments since the previous review in 1976. It is apparent that this project has been highly productive, not only in identifying important dietary mineral problems but more importantly in developing a recognition among Latin American countries that these problems exist and should be dealt with by establishing mineral nutrition research laboratories and education porgrams.

Areas identifyed in the 1976 review as needing further study and development are briefly highlighted in the following summary.

1. Continue to strengthen the research capabilities of cooperating countries in evolving national mineral nutrition programs. Significant research has been initiated in 16 cooperating countries, directly involving 185 nationals. Surveys of mineral deficiencies and toxicities are under way, and the effectiveness of providing mineral supplements directly to livestock is being explored in a number of locations. Leadership by the University of Florida has played a vital role in stimulating cooperation among government, university and industrial personnel in seeking solutions to mineral problems in cooperating countries. Students trained by the Univesity of Florida are returning to their home countries, thus adding their newly acquired expertise to the professional resources of the region.

2. Continue to obtain more data that will be useful in defining mineral relationships among soils-plants-animals. Extensive data have been collected which indicate that correlations among soil-plant-animal are low or non-existant for the minerals studied (Fe, Mn, Na, Zn). Liver samples collected from the most productive animals toward the end of the wet season are best for determining the mineral status of certain trace minerals in grazing animals.

3. Establishment controlled experiments with cooperating ranchers and experiment stations to provide more reliable information about the benefits of mineral supplementation. Controlled experiments are now underway in five countries-- Bolivia, Brazil, Colombia, Peru, Venezuela. The primary benefits being obtained in these experiments are improved fertility and increased weight gains. In one experiment, calving percentage was increased by mineral supplementation from 50% to 75%. In one experiment weight gains were doubled as a result of mineral supplementation.

4. Establisn experiments to determine the extent of carry-over from wet to dry season grazing. Preliminary research data from an experiment in Colombia indicate that major benefits may be obtained by feed-minerals only during the rainy season. Further exploration is needed in this area.

5. Generate research data which can yield cost: benefit ratios. Considerable data have been accumulated, but not yet analyzed which will be useful in determining cost: benefit ratios from mineral supplementation. Preliminary information indicates a return of at least double the investment in correcting mineral deficiencies.

6. Encourage local examination of mineral mixtures. It has been observed that many mineral supplements sold in Latin American countries are of poor quality, not meeting the guarantees on the labels. For example, an analysis of mineral supplements being sold by five different companies in Ecudador revealed that the percent of phosphorus was substantially lower than the amount guaranteed on the mineral label, in one case being practically zero.

7. Continue research efforts to simplify methods of assessing mineral nutrition status of grazing animals. Mineral research methodology has been a substantial contribution of this project, not only in terms of simplifying and standardizing the techniques but also in developing new practical approaches that can be introduced into LDC usage.

8. Establish cooperative mineral research program in South-East Asia and African Countries. Research program have been initiated in 3 Asian countries with more reconnaissance needed to further identify appropriate locations in Africa and Asia.

FUTURE NEEDS FOR MINERAL RESEARCH AND MINERAL SUPPLEMENTATION

The Mineral Research Project has made considerable progress in certain countries, and plans should be made, where feasible, to gradually turn over much of the responsibility for future mineral research to scientists within those countries. Examples include Brazil, Costa Rica and Colombia. This transfer of responsibility should be preceded by an evaluation of the state of readiness of the scientists and the commitment of the governments in the cooperating countries. Some assistance may continue to be needed in conducting difficult assays. (Even in the United States, few laboratories can produce reliable determinations of selenium, molybdenum and cobalt). In addition, there are some difficult problems in these countries, such as "cara inchada" "falling disease", and "secadera" which could be related to mineral inadequacies and require continuing intensive efforts to solve. It would be appropriate to set the schedule for transfer in consultation with all affected parties. A three year extension of the Project may provide sufficient time for an orderly and successful transfer in those countries with the most advanced programs. However, the transfer should not be tied to an arbitrary schedule but should proceed in a manner which will ensure that the investment to date will produce useful results.

In a number of countries, the Mineral Research Project is still developing. Equipment is not yet adequate, technicians are not yet completely trained, and financial commitments for independent support of mineral research are not fully developed. Atomic absorption spectrophotometry is a basic analytical technique in mineral research and involves skills that require extensive training and experience. The instrumentation is costly and requires technological support in the form of high quality electrical service and compressed gases such as acetylene, air, nitrous oxide, hydrogen, and argon. These, of course, are not universally available. Where the necessary infrastructure and trained personnel are not available, assistance will be required if this important project is to succeed.

Some additional questions, defining areas of research which have been initiated by the University of Florida and that warrant development, include the following:

1) Can certain mineral supplements be provided successfully on an intermittent basis to reduce cost, as compared to continuous administration?

2) Can low cost mineral sources, such as slag, be identified and successfully used as supplements?

3) Can mineral supplements containing potentially toxic levels of other elements be fed safely by using them for short periods or by feeding an antagonist to the toxic element(s) simultaneously?

4) What is the cause and prevention of "cara inchada"?

5) What is the cause and prevention of "secadera"?

Other problems and other countries have been tentatively explored concerning application of the same cooperative techniques in improving livestock production through mineral research. The University of Florida team members are well-qualified professionals, have extensive on-site experience, have a record of good judgement, and would be expected to provide real assistance to those countries that are willing to cooperate in helping themselves.

RECOMMENDATIONS

With AID support the University of Florida has developed a research system that has been unusually effective in obtaining LDC involvement. Much has been accomplished with a relatively small investment of U.S. funds because of the cooperative support from each of the 16 countries involved. Mineral deficiencies have been demonstrated in each country. Government officials have been persuaded that this is a problem seriously reducing livestock production and is one that can be corrected through proper application of research and technology. They have responded by establishing research laboratories for investigating mineral deficiencies. Scientists and technicians have been trained. Closer working relationships between research and extension agencies have been stimulated. Linkages have evolved between L.A. (and to a lesser degree Asia and Africa) and U.S. scientists and among scientists from many Latin American countries that will have long lasting beneficial effects.

The review team recognizes that there must be a termination point for AID support of this project, beyond which the LDCs should be expected to continue with mineral research on their own. However, they feel that this point will not be reached within the remaining year of the project. Few of the research laboratories involved will be strong enough at that point to survive on their own. Therefore the team recommends that this project be extended two years beyond it's proposed termination in November, 1980. This would provide an additional three years to transfer full responsibiltiy to each country. They should be so informed.

The review team also recommends that the University of Florida and AID give consideration to initiating and expanding a similar program in Africa and Asia. This would require additional funds.

NAME

Lee Russell McDowell

POSITION

Associate Professor, Department of Animal Science, University of Florida, Gainesville. September 1971-1974 - Latin American Feed Composition Project. 1974-present Determination of Mineral Deficiencies and Toxicities for Cattle in Latin America.

BACKGROUND

Raised on a livestock farm which included beef cattle, dairy cattle, swine, horses and sheep.

EDUCATION

A.A.S. in Animal Husbandry - Alfred Agriculture and Technical Institute - 1961.

B.S. in Animal Science - University of Georgia - 1964.

M.S. in Animal Nutrition - University of Georgia - 1965.

Ph.D. in Animal Nutrition - Washington State University - 1971.

LANGUAGE PROFICIENCY

Ability to speak, write, read and understand Spanish.

PROFESSIONAL SOCIETIES

American Dairy Science Association, American Society of Animal Science, Gamma Sigma Delta, Alpha Zeta, American Institute of Nutrition, Council for Agricultural Sciences and Technology (CAST) and Asociación Latinoamericana de Producción Animal (ALPA).

MAJOR RESPONSIBILITIES AND ACTIVITIES IN BOLIVIA (1965-1967)

1) Staff member of "Colegio Metodista", an agricultural training school.
2) Served as a Nutritional Technician and was responsible for complete feeding regimen of Todo Santos (the largest swine farm in Bolivia).
3) Nutrition Consultant to a veterinary school in Santa Cruz.
4) Team member of "Short Courses" given to groups of farmers.
5) Consultant for Peace Corps on animal livestock problems.

PUBLICATIONS

1. McDowell, L. R., J. H. Conrad, J. E. Thomas and L. E. Harris. 1974. Latin American Tables of Feed Composition. Dept. Anim. Sci., Univ. of Florida, Gainesville. 552 pp.

2. McDowell, L. R., J. H. Conrad, J. E. Thomas and L. E. Harris. 1974. Latin American Tables of Feed Composition, Abridged. Dept. of Anim. Sci., Univ. of Florida, Gainesville, 96 pp. (In English, Spanish and Portuguese).

3. Christiansen, W. C., L. R. McDowell, J. Eggleston and F. E. Weller. 1973. Latin American Livestock Feed Composition Project. p. 401-406. University of Florida Symposium - Effect of processing on the nutritional value of feeds. National Academy of Sciences, Washington, D. C.

4. McDowell, L. R. 1976. Beef cattle production in developing countries. p. 216-241. University of Edinburgh, Center for Tropical Veterinary Medicine. Edited by A. J. Smith.

5. Fick, K. R., L. R. McDowell and R. H. Houser. 1976. Current status of mineral research in Latin America. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. March 22-26, Belo Horizonte, Brazil. p. 261-297.

6. McDowell, L. R., Froseth, J. A., Piper, R. C., Dyer, I. A. and Kroening, G. H. 1977. Tissue selenium and serum tocopherol concentrations in selenium-vitamin E deficient pigs fed peas (Pisum sativum). J. Anim. Sci. 45: 1326-1333.

7. McDowell, L. R. and Conrad, J. H. 1977. Trace Mineral Nutrition in Latin America. World Animal Review, No. 24, p. 24-33.

8. McDowell, Lee R., Conrad, Joe H., Thomas, Jenny E., Harris, Lorin E. and Fick, Karl R. 1977. Nutritional composition of Latin American forages. Tropical Animal Production 2:273-279.

9. McDowell, Lee R., Froseth, John A. and Piper, Richard C. 1978. Influence of arsenic, sulfur, cadmium, tellurium, silver and selenium on the selenium-vitamin E deficiency in the pig. Nutr. Rep. Ing. 17:19-33.

10. Houser, R. H., Fick, K. R. and McDowell, L. R. 1976. O cobalto na nutriçao dos ruminantes. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. Belo Horizonte, Brazil. pp. 193-201.

11. Kiatoko, M., McDowell, L. R., Fick, K. R., Fonseca, H., Camacho, J., Loosli, J. K. and Conrad, J. H. 1978. Mineral status of cattle in the San Carlos region of Costa Rica. J. Dairy Sci. 61:324-330.

12. McDowell, L. R., Conrad, J. H., Loosli, J. K. and Ammerman, C. B. 1978. La importancia de suplementos minerales en el ganado. Seventh Symposium of Nutrition and Animal Health for Central American and Panamí. p. 1-30. San José. Costa Rica.

13. McDowell, L. R., Conrad, J. H., Loosli, J. K. and Morillo, Daivd. 1979. Results of Mineral Research in Latin America. Thirteenth Annual Conference on Livestock and Poultry in Latin America. University of Florida, Gainesville, pp. B12-B29.

14. Fick, K. R., McDowell, L. R. and Houser, R. H. 1976. Atual situação da pesquisa de minerais na América Latina. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. pp. 261-297. Belo Horizonte, Brazil.

15. Houser, R. H., McDowell, L. R. and Fick, K. R. 1976. Avaliação de suplementos minerais para ruminantes. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. p. 181-192. Belo Horizonte, Brazil.

NAME

Joseph Henry Conrad

POSITION

Professor of Animal Nutrition and Coordinator of Tropical Animal Science Programs

UNIVERSITY DEGREES

B.S. in Agriculture, Purdue University, 1950

M.S. in Animal Nutrition, Purdue University, 1954

Ph.D. in Animal Nutrition, Purdue University, 1958

Professor Honoris Causa, Rural University of the State of Minas Gerais, Viçosa, Minas Gerais, Brazil, 1965

POSITIONS HELD AND MAJOR CLASSIFICATION

Purdue University	Instructor, Animal Husbandry	1952-1958
Purdue University	Assistant Professor, swine nutrition research and in charge of swine nutrition unit	1958-1962
Purdue University	Associate Professor, swine nutrition, research and teaching	1962-1967
Rural University, State of Minas Gerais, Brazil	Animal Nutritionist, Brazil Technical Assistance Program, teaching, research and extension in Animal Nutrition	1961-1965
Purdue University	Professor of Animal Nutrition	1967-1971
University of Florida	Professor of Animal Nutrition and Coordinator of Tropical Animal Science Programs	1971-to date

COMMITTEES

National Academy of Sciences-National Research Council: Chairman, Feed Composition Committee, 1973-to date; Committee on Nutrient Requirements of Swine, 1966-1973.

American Society of Animal Science Committee on International Animal Agriculture, 1972-1976.

American Society of Animal Science Representative to the IV World Conference of Animal Production, August 20-29, 1978, Buenos Aires, Argentina, and currently ASAS Representative to World Association for Animal Production.

Secretary-Treasurer, American Society of Animal Science Midwest Section, 1970-1972.

Past Chairman and Vice Chairman, North Central Region-42 Committee on Swine Nutrition.

AWARDS

Distinguished Nutritionist Award, Distillers Feed Research Council, 1964.

Honorary Degree: Rural University of the State of Minas Gerais, "Professor Honoris Causa," 1965.

MEMBERSHIP IN PROFESSIONAL AND SCIENTIFIC ORGANIZATIONS

American Society of Animal Science, Latin American Association of Animal Production, Brazilian Society of Animal Science, Mexican Society of Animal Production, Sigma Xi, and Gamma Sigma Delta.

PUBLICATIONS

Is the author or co-author of 160 scientific publications and articles on animal nutrition. A portion of these articles are included in the following:

1. Sousa, J.C. de, J.H. Conrad, W.G. Blue and L.R. McDowell. 1979. Inter-relações entre minerais no solo, plantas forrageiras e tecido animal. I. Calcio e fósforo. Pesq. Agropec. Bras. 14:387-395.

2. McDowell, L.R., J.H. Conrad, J.K. Loosli and David Morillo. 1979. Results of Mineral Research in Latin America. Thirteenth Annual Conference on Livestock and Poultry in Latin America. University of Florida, Gainesville, p. B12-B29.

3. Conrad, J.H. 1978. Soil, plant and animal tissues as predictors of mineral status of ruminants. In Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. March 22-26, Belo Horizonte, Brazil, p. 251-260, University of Florida, Gainesville.

4. Conrad, J.H., J.C. Sousa, M.O. Mendes, W.G. Blue and L.R. McDowell. 1978. Fe, Mn, Na and Zn interrelationships in a tropical soil, plant and animal system. World Conference on Animal Production Summaries, Buenos Aires, Argentina, p. 80.

5. Conrad, J.H., J.C. Sousa, M.O. Mendes, and L.R. McDowell. 1978. Trace element interrelationships among soils, plants and ruminants. Third World Congress on Animal Feeding, Madrid, Spain. p. 33.

6. McDowell, L.R., J.H. Conrad, J.K. Loosli and C.B. Ammerman. 1978. La importancia de suplementos minerales en el ganado. Seventh Symposium of Nutrition and Animal Health for Central America and Panama. San Jose, Costa Rica, pp. 1-30.

7. Kiatoko, M., L.R. McDowell, K.R. Fick, H. Fonseca, J. Camacho, J.K. Loosli and J.H. Conrad. 1978. Mineral status of cattle in the San Carlos region of Costa Rica. J. Dairy Sci. 61:324-330.

8. Mendes, M.O., J.H. Conrad, R.H. Houser, and L.R. McDowell. 1978. Liver biopsy and season as factors in determining Co, Cu, Fe, Mn, Mo, and Zn status of grazing cattle. Abstract of the 70th Annual Meeting of the American Society of Animal Science. p. 540.

9. Mendes, M.O., J.H. Conrad, C.B. Ammerman, L.R. McDowell and R.C. Litell. 1978. Mineral liver concentrations in cattle as affected by age, physiological state and season. XI International Congress of Nutrition, Rio de Janeiro, Brazil. p. 30.

10. McDowell, Lee R. and Joe H. Conrad. 1977. Trace Mineral Nutrition in Latin America. World Animal Review 24:24-33.

11. McDowell, Lee R., Joe H. Conrad, Jenny E. Thomas, Lorin E. Harris and Karl R. Fick. 1977. Nutritional Composition of Latin American Forages. Tropical Animal Production 2:273-279.

12. Conrad, J.H. 1976. Constraints on improvement of plant and animal resources. Proceedings World Food Conference of 1976. June 27-July 1, Iowa State University, Ames, Iowa.

13. Conrad, J.H. and W.M. Beeson. 1957. Effect of calcium level and trace minerals on the response of young pigs to unidentified growth factors. J. Anim. Sci. 16:589-599.

14. Conrad, J.H., T.W. Perry, B.D. Virgin and R.B. Harrington. 1969. Vitamin E, selenium, normal and opaque-2, regular and high moisture corn for G-F swine. J. Animal Sci. 29:131 (Abstr.).

15. McDowell, L.R., K.R. Fick, R.H. Houser, J.H. Conrad and J.K. Loosli. 1977. Meeting mineral requirements for grazing livestock in the tropics. In: Symposium on feed composition, animal nutrient requirements, and computerization of diets. Utah State University, Logan, Utah, p. 374-385.

16. McDowell, L.R., J.H. Conrad, J.E. Thomas and L.E. Harris. 1974. Latin American Tables of Feed Composition, abridged. Dept. of Anim. Sci., University of Florida, Gainesville, 96 pp. (In English, Spanish and Portuguese).

17. Ammerman, C.B., K. Fick, J.H. Conrad, E.C. Araujo and W.E. Baker. 1975. Problema de flúor en rumiantes que reciben fósfatos grado fertilizante. Proceedings ALPA, paper R-11 (Abstract).

NAME

John K. Loosli

POSITION

Adjunct Professor, Animal Science Department, University of Florida, Gainesville, Florida.

EDUCATION

B.S. Animal Husbandry, Utah State University, 1931.

M.S. Animal Nutrition, Colorado State University, 1932

Ph.D. Animal Nutrition, Cornell University, 1938.

ORGANIZATIONS

American Society of Animal Science Honorary Fellow, American Dairy Science Association, American Institute of Nutrition, British Society of Animal Production, American Chemical Society, Society for Experimental Biology and Medicine, Sigma Xi, Phi Kappa Phi, Alpha Zeta, Rotary Club.

HONORS AND RECOGNITION

American Feed Manufacturers Award in Animal Nutrition 1950.

Borden Award in Dairy Production 1951.

Morrison Award 1958.

EXPERIENCE

Instructor, College of Southern Utah 1932-35; Nutritionist Bureau Biological Survey 1938-39; Cornell University, Asst. Prof. 1939-42; Assoc. Prof. 1942-45, Professor 1945-74. Head of Department 1963-71, Emeritus Professor of Animal Nutrition 1974. Visiting Professor University of the Philippines 1953-1954, 1966; University of Ife 1962; University of Ibadan, 1972-74; University of Florida 1974-79. Nutrition Consultant U.S. Army Graduate School, Walter Reed Medical Center 1954-62; University of Florida 1958; U.S. A.I.D., Nigeria 1959; IRI Research Institute, Brazil 1969, U.S.A.I.D. Mexico 1975. Collaborator, USDA 1939-1968. Fulbright Lecturer, University of Queensland, Australia 1960. Associate Editor and Editor, Journal of Animal Science 1952-1957. Member Secretary of Agriculture's Committee on Agricultural Science 1962-1967. Acting Chairman, Animal Science Department, University of Florida, 1975-1976. Acting Assistant Dean, IFAS, University of Florida, 1978. Associate Editor, Journal of Nutrition 1979-.

TEACHING RESPONSIBILITY

Animal Production in the Tropics

RESEARCH ACTIVITIES

Nutritional requirements of domestic and laboratory animals. Cooperating on project, "Mineral requirements and toxicities of grazing cattle in Latin America." Coordination of research with Dr. L.R. McDowell in Guatemala, El Salvador, Costa Rica, Bolivia, Philippines, Indonesia and Malaysia.

SELECTED PUBLICATIONS (Related to mineral nutrition)

1. Loosli, J.K. 1) Mineral problems related to tropical climates
   2) Sodium chloride requirements of ruminants
   Symposium on mineral requirements and toxicities of grazing ruminants in Latin America, Belo Horizonte, Brazil, March, 1976.
2. Loosli, J.K. Effects of processing on the availability and nutritive value of calcium, phosphorus and magnesium supplements. Effect of processing on the nutritional value of feeds. National Academy of Sciences, 1973.
3. Coppock, C.E., R.S. Adams, E.M. Kesler and J.K. Loosli. Complex mineral-vitamin supplementation for dairy cows. Penn and Cornell Exp. Sta. Bull. 759. 1970.
4. Mathias, M.M., D.E. Hogue and J.K. Loosli. The biological value of selenium in bovine milk for the rat and chick. J. Nutr. 93:14. 1967.
5. Perez, C.B., R.G. Warner and J.K. Loosli. Evaluation of urea-phosphate as a source of nitrogen and phosphorus for ruminants. J. Animal Sci. 26:810. 1967.
6. Carrillo, B.J., W.G. Pond, L. Krook, F.E. Lovelace and J.K. Loosli. Response of growing rats to diets varying in magnesiym, potassium and protein contents. Proc. Soc. Expt. Biol. & Med. 107:793. 1961.
7. Pond, W.G., R.S. Lowery, J.H. Maner and J.K. Loosli. Parenteral iron administration to sows during gestation or lactation. J. Animal Sci. 20:747. 1961.
8. Smith, S.E. and J.K. Loosli. Cobalt and Vitamin B12 in ruminant nutrition: A review. J. Dairy Science 40:1512. 1957.
9. Bolcita, A.N., G.V. Garcia, L. Austria, L.A. Ynalvez and J.K. Loosli. Carotene, Vitamin A and inorganic phosphorus content of blood plasma of cattle and carabaos. Philippine Agric. 38:388. 1954.
10. Davis, G.K. and J.K. Loosli. Mineral metabolism-Animal. Ann. Rev. Biochem. 23:459. 1954.
11. Visek, W. J., L.L. Barnes and J.K. Loosli. Calcium metabolism in lactating goats as studied with ^{45}Ca following oral and intravenous administration. J. Dairy Sci. 35:783. 1952.
12. Thomas, W.E., J.K. Loosli, H.H. Williams and L.A. Maynard. The utilization of inorganic sulfates and urea nitrogen by lambs. J. Nutrition. 43:515. 1951.

NAME

Clarence Bailey Ammerman

POSITION

Professor of Animal Nutrition, Department of Animal Science, University of Florida, Gainesville.

EDUCATION

B.S. in Agriculture - University of Kentucky - 1951.

M.S. in Animal Nutrition - University of Kentucky - 1952.

Ph.D. in Animal Science - University of Illinois - 1956.

PROFESSIONAL SOCIETIES

Sigma Xi, Phi Sigma, Gamm Sigma Delta, Alpha Zeta, American Society of Animal Science, American Institute of Nutrition, American Dairy Science Association, American Association for the Advancement of Science, Society for Experimental Biology and Medicine, and Asociación Latinoamericana de Producción Animal.

HONORS AND RECOGNITION

B.S. degree "with distinction", University of Kentucky, 1951.
Junior Faculty Award of Merit for Research, Gamma Sigma Delta, University of Florida, 1967.
Member, Editorial Board, Journal of Animal Science, 1967-1970.
Moorman Travel Fellowship for Animal Nutrition Research, National Feed Ingredients Association, 1969.
Gustav Bohstedt Award for Mineral and Trace Mineral Research ($1000), American Society of Animal Science, 1973.
American Feed Manufacturers Association Nutrition Research Award ($1000), American Society of Animal Science, 1977.
Senior Faculty Award of Merit for Research, Gamma Sigma Delta, University of Florida, 1979.

TEACHING RESPONSIBILITY

Graduate Course entitled "Mineral Nutrition and Metabolism".

RESEARCH ACTIVITIES

1) Author or co-author of some 225 scientific papers, more than one half of which are in the field of mineral nutrition. Other areas of research include: the evaluation of by-product feedstuffs, biological availability of nutrients in feeds and the evaluation of low quality roughages.

2) Director of graduate research programs for 33 candidates for the M.S. or the Ph.D. degree.

3) Traveled or had agricultural experience in Brazil, Mexico, Guatemala, El Salvador, Costa Rica, Panama, Colombia, Venezuela, Guyana and several other countries.

PUBLICATIONS

Recent journal articles relating to mineral nutrition:

1. Ammerman, C. B. and S. M. Miller. 1975. Selenium in ruminant nutrition: A review. J. Dairy Sci. 58:1561.

2. Fick, K. R., C. B. Ammerman, S. M. Miller, C. F. Simpson and P. E. Loggins. 1976. Effect of dietary lead on performance, tissue mineral composition and lead absorption in sheep. J. Anim. Sci. 42:515.

3. Ammerman, C. B., S. M. Miller, K. R. Fick and S. L. Hansard II. 1977. Contaminating elements in mineral supplements and their potential toxicity: A review. J. Anim. Sci., 44:485.

4. Valdivia, R., C. B. Ammerman, J. P. Feaster, P. E. Loggins and P. R. Henry. 1977. Effect of aluminum on phosphorus utilization by lambs. Abstracts, 69th Annual Meeting. American Society Animal Science, p. 265 (Abstract).

5. Lebdosekojo, S., C. B. Ammerman, N. Raun, J. Gomez and R. Littell. 1977. Suplementación mineral del ganado en pastoreo en los llanos orientales de Colombia. Proc. VI. Reunión Asociación Latinoamericana de Producción Animal. Abs. No. R-52, p. 52 (Absrtact).

6. Ammerman, C. B. and S. L. Hansard. 1978. Toxicity of vanadium in sheep. Proc. 3rd International Sumposium on Trace Element Metabolism in Man and Animals, p. 614.

7. Hansard, S. L. II., C. B. Ammerman, K. R. Fick and S. M. Miller. 1978. Performance and vanadium content of tissues in sheep as influenced by dietary vanadium. J. Anim. Sci. 46:1091.

8. Valdivia, R., C. B. Ammerman, C. J. Wilcox and P. R. Henry. 1978. Effect of dietary aluminum on animal performance and tissue mineral levels in growing steers. J. Anim. Sci. 47:1351.

9. Ammerman, C. B. 1979. Trace Minerals. P. 325 in Large Dairy Herd Management. C. J. Wilcox and H. H. Van Horn, (Eds.) University Presses of Florida, Gainesville, Florida.

10. Valdivia, R. and Clarence B. Ammerman. 1979. Efecto do la ingestión de suelos en la absorción del fósforo en ovinos. Proc. VII. Reunión Asociación Latinoamericana de Producción. No. R-60 (Abstract).

Name: Ray L. Shirley

Position: Professor Animal Nutrition, In Charge Nutrition Laboratory
Department of Animal Science, University of Florida

1.

2. Degrees (institutions and dates):

B. S. West Virginia University, 1937

M. S. West Virginia University, 1939

Ph.D. Michigan State University, 1949

3. Professional Experience:

Assistant Professor of Agricultural Biochemistry, Michigan State University, 1941-1942.

Research Chemist, Hercules Research Center, Wilmington, Delaware, 1942-47.

Assistant Professor of Agricultural Biochemistry, Michigan State University, 1947-49.

Biochemist and Professor of Animal Nutrition, University of Florida, 1949-51.

Professor of Chemistry, Shepherd College, 1951-53.

Professor of Animal Nutrition, University of Florida, 1953-present, In Charge of Nutrition Laboratory since 1961.

4. Membership in Professional and Scientific Organizations:

Alpha Zeta, Honorary Agricultural Society

Phi Lambda Upsilon, Honorary Chemical Society

Sigma Xi, Honorary Scientific Society

Gamma Sigma Delta, The Honor Society of Agriculture - Secretary 1960-62; Vice-President, 1962-63; President, 1963-64 University of Florida chapter.

American Society of Animal Science

American Institute of Nutrition

American Society of Dairy Science

American Chemical Society

American Society for the Advancement of Science, Fellow (1967)

Society of Experimental Biology and Medicine, Chairman, Southeastern Section, 1966-67.

5. Awards:

   a. Annual Sigma XI Faculty Research Award, University of Florida 1960.

   b. Calcium Carbonate Company (CCC) $1000 Travel Award for Trace Mineral Research, 1967. National Feed Ingredient Association.

   c. Annual Gamma Sigma Delta, Senior Faculty Award of Merit. University of Florida. 1974.

   d. Gustav Bohstedt Award. 1975. Mineral Research, American Society of Animal Science.

6. Publications: 228

   1. Shirley, R. L., Marvin Koger, H. L. Chapman, Jr., R. W. Kidder, P. E. Loggins and J. G. Easley. 1966. Selenium and weaning weights of cattle and sheep. J. Anim. Sci. 25:648-651.

   2. Shirley, R. L. and J. F. Easley. 1976. Molybdenum in the femurs and teets of rats. Molybdenum in the Environment, pp. 221-228. Edited by W. R. Chappell and Kathy K. Petersen. Publ. by Marcel Dekker, Inc. N. Y.

   3. Shirley, R. L. 1976. Sulfur in Animal Nutrition. Proc. Latin American Symposium on Mineral Research with Grazing Ruminants. Belo Horizonte, Brazil, March 22-26.

   4. Perdomo, J. T., R. L. Shirley and C. F. Chicco. 1977. Availability of nutrient minerals in four tropical forages fed freshly chopped to sheep. J. Anim. Sci. 45:1114-1119.

   5. Padgett, D. G., R. L. Shirely and J. F. Easley. 1978. Nutrient digestibility in diets fed steers in which whole cattle blood was substituted for peanut meal on a protein basis. J. Anim. Sci. 46:746-752.

   6. Lane, Helen, R. L. Shirley and J. J. Cerda. 1978. Glutathione peroxidase activity in intestinal and liver tissues of male rats fed various levels of selenium, α-tocopherol and sulfur. Federation Proc. Atlantic City, April 9-14 (Abstr. No. 2592).

   7. Shirley, R. L., W. G. Kirk, G. K. Davis and E. M. Hodges. 1970. Breaking strength, density and mineral composition of bone of cows grazing phosphorus fertilized pangolagrass. Quart. J. Fla. Acad. Sci. 33:111-118.

NAME: Harold D. Wallace

POSITION: Chairman, Animal Science Department, University of Florida

DEGREES:

B.S.	University of Illinois	1945
M.S.	University of Illinois	1947
Ph.D.	Cornell University	195^

PROFESSIONAL EXPERIENCE:

Assistant Professor of Nutrition, University of Florida, 1950-1954.

Associate Professor of Animal Nutrition, University of Florida, 1954-57.

Professor of Animal Nutrition, University of Florida, 1957-76.

Chairman, Animal Science Department, University of Florida, 1976 to present.

MEMBERSHIP IN PROFESSIONAL AND SCIENTIFIC ORGANIZATIONS:

Alpha Zeta
Gamma Sigma Delta
Sigma Xi
American Society of Animal Science
American Institute of Nutrition
American Dairy Science Association
Florida Swine Producers Association
Florida Cattlemen's Association

AWARDS:

Recipient of Junior Faculty Award, Florida Chapter, Gamma Sigma Delta, 1958.

Fellow American Society for Advancement of Science, 1959.

Recipient of $1,000 American Feed Manufacturers Award for outstanding research in swine nutrition, 1962.

Recipient of Distinguished Nutritionist Award from Distillers Feed Research Council, 1964.

Recipient of Ralph Leighty Sportsmanship Trophy Award, U.F. Bowling League, 1972.

Recipient of Florida Swine Producers Outstanding Swine Producer Award, 1973.

PUBLICATIONS: Is author or co-author of 275 scientific publications, 83 abstracts and 79 popular articles. A portion of the publications are listed as follows:

1. Wallace, H. D., J. K. Loosli and K. L. Turk. 1951. Substitutes for fluid milk in feeding dairy calves. J. Dairy Sci. 34:256-264.

2. Wallace, H. D., R. L. Shirley and G. K. Davis. 1951. Excretion of Ca-45 by the rat intestine. J. Nutr. 43:469-475.

3. Wallace, H. D., W. A. Ney and T. J. Cunha. 1951. Various antibiotics and 3-nitro-4-hydroxyphenyl arsonic acid in corn peanut meal rations for swine. Proc. Soc. Exp. Biol. and Med. 78:807-808.

4. Braude, R., H. D. Wallace and T. J. Cunha. 1953. The value of antibiotics in the nutrition of swine. A review. Antibiotics and Chemotherapy 3:271-291.

5. Wallace, H. D., L. T. Albert, W. A. Ney, G. E. Combs and T. J. Cunha. 1953. Effects of reducing and discontinuing aureomycin supplementation during the growing-fattening period of pigs fed corn-peanut meal, corn-soybean meal and corn-cottonseed meal rations. J. Anim. Sci. 12:316-321.

6. Wallace, H. D., M. Milicevic, A. M. Pearson, T. J. Cunha and M. Koger. 1954. The influence of aureomycin on the protein requirements and carcass characteristics of swine. J. Anim. Sci. 13:177-183.

7. Wallace, H. D., J. McKigney and L. Gillespie. 1954. The influence of subcutaneous implantation of bacitracin and chlortetracycline (Aureomycin) pellets on the growth and survival of suckling pigs. Antibiotics and Chemotherapy 4:663-665.

8. Wallace, H. D., J. I. McKigney, A. M. Pearson and T. J. Cunha. 1955. The influence of chlortetracycline on the growth and carcass characteristics of swine fed restricted rations. J. Anim. Sci. 14:1095-1102.

9. McKigney, J. I., H. D. Wallace and T. J. Cunha. 1957. The influence of chlortetracycline on the requirement of the young pig for dietary pantothenic acid. J. Anim. Sci. 16:35-43.

10. Haines, C. E., A. C. Warnick and H. D. Wallace. 1958. The effect of exogenous progesterone and level of feeding on prenatal survival in gilts. J. Anim. Sci. 17:879-885.

11. Combs, G. E., H. D. Wallace, W. L. Alsmeyer and M. Koger. 1959. Growth potential of swine as measured by serum alkaline phosphatase. J. Anim. Sci. 18:361-364.

12. Wallace, H. D., C. E. Norris, G. E. Combs, G. E. McCabe and A. Z. Palmer. 1959. Influence of triiodothyronine on feedlot performance and carcass characteristics of growing-finishing swine. J. Anim. Sci. 18:1018-1024.

13. Pekas, J. C., G. E. Combs, J. M. Vandepopuliere and H. D. Wallace. 1959. Hypoglycemic compounds as appetite stimulants for baby pigs. J. Anim. Sci. 18:1282-1291.

14. Wallace, H. D., J. T. McCall, Billy Bass and G. E. Combs. 1960. High level copper for growing-finishing swine. J. Anim. Sci. 19:1153-1163.

15. Shirley, R. L., H. D. Wallace and G. K. Davis. 1961. Relative frequency of loss of individual molars of rats during a longevity study. J. of Dental Res. 40:1155-1159.

16. Goode, L., A. C. Warnick and H. D. Wallace. 1965. Effect of dietary energy levels upon reproduction and the relation of endometrial phosphatase activity to embryo survival in gilts. J. Anim. Sci. 24:959-963.

17. Combs, G. E., C. B. Ammerman, R. L. Shirley and H. D. Wallace. 1966. Effect of source and level of dietary protein on pigs fed high-copper rations. J. Anim. Sci. 25:613.

18. Wallace, H. D. 1967. High level copper in swine feeding. A review of research in the United States. Published by the International Copper Research Association, Inc., New York, New York.

19. Wallace, H. D. 1970. Biological responses to antibacterial feed additives in diets of meat producing animals. J. Anim. Sci. 31: 1118-1126.

20. Bazer, Fuller W., F. A. Murray, Jr. and H. D. Wallace. 1972. Corpora lutea function and pregnancy maintenance in gilts following unilateral ovariectomy, unilateral uterine horn transection and unilateral ovariectomy-uterine horn transection. J. Anim. Sci. 35:569-571.

21. Knight, J. W., Fuller W. Bazer and H. D. Wallace. 1973. Hormonal regulation of porcine uterine protein secretions. J. Anim. Sci. 36:546-553.

22. Standish, J. F., C. B. Ammerman, H. D. Wallace and G. E. Combs. 1975. Effect of dietary molybdenum and sulfate on copper plasma clearance and tissue minerals in growing swine. J. Anim. Sci. 40:509-513.

23. Campabadal, C., D. Creswell, H. D. Wallace and G. E. Combs. 1976. Nutritional value of rice bran for pigs. Tropical Agriculture (Trinidad) 53, No. 2, p. 141-149.

NAME

John Edward Moore

POSITION

University of Florida, 1961 to present, Professor:

- Teach: Animal Nutrition (ANS 5456)
  Applied Animal Nutrition (ASG 3404)

- Research: Forage Quality Evaluation
  - compare forages (intake and digestibility)
  - predict quality from laboratory analyses

- Graduate Programs: Direct 11 Ph.D., 16 M.S.; member 95 committees.
  Member, Graduate Council.

- International Programs: Travels to Ecuador, Venezuela, Cuyana, Trinidad, Dominican Republic, Costa Rica and Australia.

BACKGROUND

Born and raise in central Ohio (small farm, family feed, grain and hardware business).

EDUCATION

B.S., M. S., Ph.D. (1961) Ohio State University (Ruminant Nutrition).

PROFESSIONAL SOCIETIES (Offices)

Chairman, Southern Pasture and Forage Crop Improvement Conference, 1979.

Board of Directors, American Forage and Grassland Council 1972-74, 1977-present.

AWARDS

Junior Faculty, Florida Chapter, Gamma Sigma Delta, 1972.

Merit Certificate, Am. Forage and Grassland Co., 1976.

Distinguished Alumnus, Ohio State University, Animal Science Dept., 1977.

PUBLICATIONS

1. Moore, J. E., R. R. Johnson and B. A. Dehority. 1962. Adaptation of an *in vitro* system to the study of starch fermentation by rumen bacteria. J. Nutr. 76:414.

2. Martin, J. E., L. R. Arrington, J. E. Moore, C. B. Ammerman, G. K. Davis and R. L. Shirley. 1964. Effect of magnesium and sulfur upon cellulose digestion. J. Nutr. 83:60.

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Literature from Research Program

1. Titles and authors of papers presented at the 1976 Latin American Symposium on Mineral Research with Grazing Ruminants, Belo Horizonte, Brazil. Publication of Symposium Proceedings in both English and Spanish were published in 1979. These proceedings were updated from the 1976 printing.
2. Bibliographic list of publications from November 1974 through December 1977.
3. Abstracts (or summaries) of selected papers submitted for publication or published in 1978 to June 1, 1979. Abstracts dated 1977 but which were not part of the last annual report are also included.

1. Latin American Symposium on Mineral Research with Grazing Ruminants

Belo Horizonte, Brazil
March 22-26, 1976
(Listed in Order of Presentation)

1. Mineral Problems as Related to Tropical Climates, J. K. Loosli (Florida) and Antonio Carlos Guedes (UF Santa Maria).

2. Classification and Distribution of Tropical Soils, Raimundo Costa de Lemos (CESA and SEMBIA - Rio de Janeiro).

3. Methods of Analyzing Soil Fertility José Mario Braga (UF Viçosa).

4. Properties of Soil which Affect the Availability of Minerals for Plants and Animals, S. J. Volkweiss (UFRGS - Porto Alegre).

5. Mineral Composition of Tropical Grasses and Forage Legumes, José Alberto Gomide (UF Viçosa).

6. Water as a Source of Minerals, R. L. Shirley (Florida) and Jose Herculano de Carvalho (UA, Teresina, PI).

7. Magnesium in Ruminant Nutrition, J. A. Carneiro Viana, (UF Minas Gerais).

8. Copper and Molybdenum in Ruminant Nutrition, José Fernando Cocit da Silva, (UF Viçosa).

9. Sample Preparation and the Analysis of Animal Tissues, R. M. Silva (UF Minas Gerais).

10. Calcium, Phosphorus, and Fluorine in Ruminant Nutrition, D. J. Thompson (International Minerals and Chemical Corp. Joaquim C. Werner (Nova Odessa, S.P.).

11. Sodium and Chlorine in Ruminant Nutrition, J. K. Loosli (Florida) and José Ribeiro (UFRGS - Porto Alegre).

12. Sample Preparation and Soil Analyses, Victor Gonçalves Bahia, (USP - Pirmicaba).

13. Potassium and Iodine in Ruminant Nutrition, D. J. Thompson (International Minerals and Chemical Corporation) and João M.S. Andrade (EPAMIG - Belo Horizonte).

14. Sulfur in Ruminant Nutrition, R. L. Shirley (Florida) and Artur Mariante (EMBRAPA-Brasília).

15. Selenium in Ruminant Nutrition, C. B. Ammerman (Florida), S. M. Miller (Florida), L. R. McDowell (Florida) and Edvaldo Correca de Araujo (EMBRAPA-Recibe).

16. Iron, Manganese and Zinc in Ruminant Nutrition, L. R. McDowell (Florida), R. H. Houser (Florida), K. R. Fick (Florida) and Marcelo O. Mendes (EMBRAPA - Rio de Janeiro).

17. Cobalt in Ruminant Nutrition, R. H. Houser (Florida), K. R. Fick (Florida), L. R. McDowell (Florida) and José Herculano de Carvalho (MA - Teresina - PI).

18. Newer Elements, Essential and Toxic, in Mineral Nutrition, L. R. McDowell, K. R. Fick, C. B. Ammerman, S. M. Miller, R. H. Houser (Florida) and Júlio Cesar de Sousa (EMBRAPA - Sete Lagoos).

19. Biological Availability of Macro Elements, D. J. Thompson (International Minerals and Chemical Corporation) and Marcelo O. Mendes (EMBRAPA - Rio de Janeiro).

20. Biological Availability of Micro Elements - A review, C. B. Ammerman, S. M. Miller (Florida) and José Herculano de Carvalho (MA - Teresina - PI).

21. Soil, Plant, and Animal Tissue as Predictors of the Mineral Status of Ruminants, J. H. Conrad (Florida) and Júlio Cesar de Sousa (EMBRAPA - Sete Lagoos).

22. Evaluation of Mineral Supplements for Ruminants, R. H. Houser (Florida) and Leonidas Valle (EMBRAPA - Brasília).

23. Current Status of Mineral Research in Latin America, K. R. Fick, L. R. McDowell, R. H. Houser (Florida), and Hamilton da Silva (UFMG - Belo Horizonte).

24. Mineral Deficiencies of Cattle under Range Conditions in Brazil Carlos Hubinger Tokarnia (UFF - Niteroi) and Jurgen Dobereiner (EMBRAPA - Rio de Janeiro).

25. Mineral Research Studies of Ruminants in the Amazon Region, Nelson S. Fernandes and Waldemar V. Camargo (Biological Institute, São Paulo).

26. What Type of Information Do the Mineral Companies Need from the Researchers, João Soares Veiga (TORTUGA - São Paulo).

27. Identification and Supplementation of Limiting Nutrients for Grazing Ruminants D. J. H. Van Niekerk (Voermol Products - South Africa) and E. Adilson S. Serrão (EMBRAPA, Belém).

2. Bibliographic list of publications from November, 1974 through December, 1977.

a) McDowell, L. R., J. H. Conrad, J. E. Thomas and L. E. Harris. 1975. Nutritional composition of Latin American Feeds. Proceedings of a conference on "Animal Feeds of Tropical and Sub-tropical Origin," p. 253-254. Tropical Products Institute, London, England.

b) McDowell, L. R., J. H. Conrad, J. E. Thomas and L. E. Harris. 1975. Latin American forages. J. Anim. Sci. 41:282. (Abstr.).

c) Lang, Carlos E., L. R. McDowell, J. H. Conrad and Hernán Fonseca. 1975. Estado mineral del ganado en Guanacaste, Costa Rica. ALPA. R2 (Abstr.).

d) McDowell, L. R. 1975. Niveles minerales relacionados al crecimiento animal en América Latina. 3rd. Latin American Meats Short Course, pp. 33, Gainesville, Florida.

e) Gil, Arturo, Lee McDowell y Joseph Tritschler. 1975. Deficiencias y toxicidades de minerales para bovinos en las principales áreas ganaderas del país. p. 110-115. Informe anual del programa nacional de nutrición animal. ICA - Tibaitatá.

f) McDowell, L. R. 1976. Mineral deficiencies and toxicities and their effect on beef production in developing countries. Beef cattle production in developing countries. p. 216-241. Edited by A. J. Smith. Edinburgh, Scotland.

g) Fick, Karl, Sarah M. Miller, John D. Funk, Lee R. McDowell and Richard M. Houser. 1976. Methods of mineral analysis for plant and animal tissues. 60 pp. University of Florida, Gainesville, Florida (English, Spanish and Portuguese).

h) Mangeye K., L. R. McDowell, K. R. Fick, H. Fonseca, J. A. Camacho and J. K. Loosli. 1976. Mineral status of cattle in San Carlos, Costa Rica. J. Anim. Sci. 43:326 (Abstr.).

i) Gil, Arturo, Lee McDowell and Joseph Tritschler. 1977. Deficiencias y toxicidades de minerales para bovinos y ovinos en las principales áreas ganaderas del país. Programa Nacional de Nutrición Animal. Informe Anual de 1976. Bogotá, Colombia.

j) McDowell, Lee R. 1977. Investigaciones minerales en ganado en Latinoamérica. Segundo Curso en Nutrición y Alimentació... p. 1-24. Lima, Perú.

k) McDowell, L. R., J. A. Froseth, R. C. Piper, I. A. Dyer and C. H. Kroening. 1977. Tissue selenium and serum tocopherol concentrations in selenium-vitamin E deficient pigs fed peas (Pisum sativum). J. Anim. Sci. 45:1326-1333.

l) McDowell, L. R. 1977. Current mineral research in Latin America. Eleventh Annual Conference on Livestock and Poultry in Latin America. p. B10-25, University of Florida, Gainesville (in English and Spanish).

m) Alonso Guzmán, Manrique. 1977. Evaluación del estado mineral del ganado y los pastos en los distritos de La Cruz, Cañas Dulces y Filadelfia de la provincia de Guanacaste durante la época seca. Tesis. Facultad de Agronomía, Universidad de Costa Rica, San José.

n) Ammerman, C. B. and Ricardo Valdivia. 1977. Mineral supplementation for beef cattle in Latin America. Eleventh Annual Conference on Livestock and Poultry in Latin America. p. B1-9, University of Florida, Gainesville (in English and Spanish).

o) Conrad, Joe H. and Lee R. McDowell. 1977. Research in mineral deficiencies for grazing ruminants. Annual report for AID mineral research project contract number AID/ta/c/1153. Gainesville, Florida.

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q) Gil, Arturo, Lee McDowell and Joseph Tritschler. 1977. Deficiencias y toxicidades de minerales para bovinos y ovinos en las principales áreas ganaderas del país. Programa Nacional de Nutrición Animal. Informe Anual de 1976. Bogotá, Colombia.

r) Lobdosoekojo, Soekanto. 1977. Mineral supplementation of grazing beef cattle in the Eastern Plains of Colombia. Ph.D. thesis. Gainesville, Florida.

s) Lobdosoekojo, S., C. Ammerman, N. Raun, J. Gómez and R. Littell. 1977. Suplementación mineral del ganado en pastoreo en los llanos orientales de Colombia. ALPA. R-52.

t) Loosli, John K. 1977. Utilización de suplementos de nitrogeno no proteico para rumiantes. Segundo Curso en Nutrición y Alimentación. p. 1-19, Lima, Perú.

u) McDowell, L. R. 1977. Current mineral research in Latin America. Eleventh Annual Conference on Livestock and Poultry in Latin America. p. B-10-25, University of Florida, Gainesville (in English and Spanish).

v) McDowell, Lee R. 1977. Investigaciones minerales en ganado en Latinoamérica. Segundo Curso en Nutrición y Alimentación. p. 1-24, Lima, Perú.

w) McDowell, Lee R., Joe H. Conrad, Jenny E. Thomas, Lorin E. Harris and Karl R. Fick. 1977. Nutritional composition of Latin American forages. Trop. Anim. Prod. 2:273-279.

x) McDowell, L. R., J. A. Froseth, R. C. Piper, I. A. Dyer and G. H. Kroening. 1977. Tissue selenium and serum tocopherol concentrations in selenium-vitamin E deficient pigs fed peas (Pisum sativum). J. Anim. Sci. 45:1326-1333).

y) McDowell, L. R., Carlos E. Lang, J. H. Conrad, Frank S. Martin and Hernán Fonseca. 1977. Mineral status of beef cattle in Guanacaste, Costa Rica. Trop. Agric. 343-350.

z) Mendes, M. O. 1977. Mineral status of beef cattle in northern part of Mato Grosso, Brazil, as indicated by age, season and sampling technique. Ph.D. dissertation, University of Florida, Gainesville.

aa) Molina, E. Orlando and Vicente León V. 1977. Melaza y minerales en la suplementación alimenticia de vaconas. Boletín Técnico No. 19, Santa Catalina, Ecuador.

bb) Murillo Bravo, Olger. 1977. Evaluación del estado de nutrición mineral del ganado bovino en pastoreo en el cantón de Cañas, Guanacaste. Tesis. Facultad de Agronomía, Universidad de Costa Rica, San José.

cc) Palmer, Francis, Luis Fdo. 1977. Evaluación del estado de nutrición mineral del ganado bovino de la Provincia de Cartago. Tesis. Facultad de Agronomía, Universidad de Costa Rica, San José.

dd) Pate, F. M. and J. R. Crockett. 1977. Honduras beef cattle project nutritional evaluation studies summary report-1977. Belle Glade, Florida.

ee) Perdomo, J. T., R. L. Shirley and C. F. Chicco. 1977. Availability of nutrient minerals in the form of tropical forages fed freshly chopped to sheep. J. Anim. Sci. 45:1114-1119.

ff) Perla, Ferdinando, Luis A. Silva, Guillermo Acosta M. and Francisco de Moreno. 1977. Estado de minerales en ganado de abasto de El Salvador. Submitted abstract for 1977 ALPA meetings, Habana. Cuba.

gg) Valdivia, Ricardo, 1977. Effect of dietary aluminum on phosphorus utilization by ruminants. Ph.D. Thesis, Gainesville, Florida.

hh) Valdivia, R., C. B. Ammerman, J. P. Feaster, P. E. Loggins and P. R. Henry. 1977. Effect of aluminum on phosphorus utilization by lambs. 1977 American Society of Animal Science abstracts p. 265.

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3. Abstracts (or summaries) of selected papers submitted for publication or published in 1978 to June 1, 1979. Abstracts dated 1977, but which were not part of the last annual report are also included.

a) Alonso Guzmán, Manrique. 1977. Evaluación del estado mineral del ganado y los pastos en los distritos de La Cruz, Caños Dulces y Filadelfia de la Provincia de Guanacaste durante la época seca. Tesis. Universidad de Costa Rica, Facultad de Agronomía, Escuela de Zootecnia, San José, Costa Rica.

b) Alpízar López, Francisco Alberto. 1978. Evaluación del estado de nutrición mineral del ganado bovino en pastoreo en el cantón de San Carlos, Alajuela. Tesis. Universidad de Costa Rica, Facultad de Agronomía, Escuela de Zootecnia, San José, Costa Rica.

c) Ammerman, C. B., R. Valdivia and P. R. Henry. 1978. Influence of dietary aluminum on growth rate and tissue mineral composition in ruminants. Proc. IV World Conference on Animal Production, P. 96.

d) Campabadal H., Carlos, Manrique Alonso G., Emilio Vargas G., Carlos Jiménez, Hernán Fonseca Z., Ismael Pontigo A. 1978. Contenido de calcio, fósforo y magnesio en el suero sanguíneo y factores que afectan estos minerales en bovinos en pastoreo en La Cruz, Caños Dulces y Filadelfia, Guanacaste, Costa Rica. Vol. 1:5 (abstract). III Congreso Agronómico Nacional, San José, Costa Rica.

e) Conrad, J. H., J. C. Sousa, M. O. Mendes and L. R. McDowell. 1978. Trace element interrelationships among soils, plants, and ruminants. III World Conference on Animal Feeding. Madrid, Spain.

f) Conrad, J. H., J. C. Sousa, M. O. Mendes, W. G. Blue and L. R. McDowell. 1978. Fe, Mn, Na and Zn interrelationships in a tropical soil, plant and animal system. IV World Conference on Animal Production. Buenos Aires, Argentina (In Press).

g) Echevarría, Mariano, Ricardo Valdivia, Oswaldo del Valle, K. Sanchirasegram, Lilia Campos y Teresa Arbaiza. 1977. Efecto de suplementación de fósforo sobre los niveles séricos y crecimiento de vaquillas en Pucallpa. VI Reunión ALPA, Habana, Cuba.

h) Echevarría, Mariano, Alfredo Blasco, Víctor Morales, Oswaldo del Valle y Mario García. 1977. Los minerales en la alimentación del ganado en el trópico de Pucallpa, Perú. 1977 ALPA proceedings, M-53. Habana, Cuba.

i) Flores, J. A., B. Murillo, M. T. Cabezas y R. Brassani. 1978. Estudio de la composición química y del valor nutritivo del pasto Pangola manejado en forma intensiva en la República de El Salvador. CENTA, República de El Salvador.

j) Flores, J. A., B. Murillo, M. T. Cabezas y Ricardo Bressani. 1978. Diagnóstico del estado de nutrición mineral del ganado de leche y de carne manejado en forma intensiva en la República de El Salvador. INCAP, República de El Salvador.

k) Flores, J. A., B. Murillo, M. T. Cabezas y R. Bressani. 1978. Diagnóstico del estado de nutrición mineral del ganado de leche y de carne manejado en forman intensiva en la República de El Salvador. INCAP, República de El Salvador.

l) Flores, J. R., J. A. Flores, M. T. Cabezas y R. Bressani. 1978. Estado de nutrición mineral del ganado de carne en tres fincas de los departamentos de Retalhuleu y Suchitepeque en la costa del Pacífico de Guatemala. Facultad de Medicina Veterinaria y Zootecnia, Universidad de San Carlos de Guatemala.

m) Flores, J. A., M. T. Cabezas y R. Bressani. 1978. Ensayo preliminar para la detección de deficiencias minerales en el ganado bovino manejado en forma extensiva en la Costa del Pacífico de Guatemala. INCAP, Guatemala, Guatemala.

n) Flores, J. A., G. Cruz-Gomar, M. T. Cabezas y R. Bressani. 1978. Contenido de minerales en pastos naturales de los departamentos de Huehuetenango y San Marcos. I. Calcio, fósforo, magnesio, sodio y potasio. INCAP. Guatemala, Guatemala.

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p) Gil, Arturo, Lucía Pabón y Patricia Jiménez. 1977. Molibdenosis en Colombia. Procedimientos VI Reunión ALPA. Habana, Cuba.

q) Gil, Arturo y Gonzalo Guzmán. 1977. Tratamiento de la selenosis en el bovino. Procedimientos VI Reunión ALPA. Habana, Cuba.

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s) Jiménez C., Carlos, Carlos Campabadal H., Manrique Alonso G., Hernán Fonseca Z., Emilio Vargas C., Ismael Pontigo A. 1978. Composición mineral de los forrajes y su interrelación con los requerimientos del ganado vacuno en los distritos de Cañas Dulces, La Cruz y Filadelfia. Vol. 1:37 (abstract). III Congreso Agronómico Nacional, San José, Costa Rica.

t) Kiatoko, M., L. R. McDowell, K. R. Fick, H. Fonseca, J. Camacho, J. K. Loosli and J. H. Conrad. 1978. Mineral status of cattle in the San Carlos region of Costa Rica. J. Dairy Sci. Vol. 61, No. 3:324-330.

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v) Kiatoko, M., L. R. McDowell, J. E. Bertrand, H. L. Chapman, F. M. Pate and J. H. Conrad. 1979. Ca, P, Mg, Na and K interrelationships among soil, forage, and animal tissues. J. Anim. Sci. (abstract).

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gg) Montoya M., Víctor, Carlos Campabadal H., Emilio Vargas G., Hernán Fonseca Z., Ismael Pontigo. 1978. Composición mineral de forrajes y su interrelación con los requerimientos de bovinos en Santa Cruz, Guanacaste durante la época seca. Vol. 1:41 (abstract). III Congreso Agronómico Nacional, San José, Costa Rica.

hh) Montoya Segura, Víctor Manuel. 1978. Evaluación del nivel de minerales en tejidos animales (sangre e hígado) y forrajes del cantón de Santa Cruz, Provincia de Guanacaste, durante la época seca. Tesis. Universidad de Costa Rica, Facultad de Agronomía, Escuela de Zootecnia, San José, Costa Rica.

ii) Montoya S., Víctor M., Carlos Campabadal H., Emilio Vargas G., Jorge Sánchez, Hernán Fonseca Z., Ismael Pontigo. 1978. Niveles sanguíneos de calcio, fósforo, y magnesio de bovinos en pastoreo en Santa Cruz, Guanacaste, durante la época seca. Vol. 1:21 (abstract). III Congreso Agronómico Nacional, San José, Costa Rica.

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oo) Pérez, R., J. A. Flores, M. T. Cabezas y R. Bressani. 1978. Estado de nutrición mineral del ganado de carne en tres fincas del departamento de Santa Rosa de la costa del Pacífico de Guatemala. Facultad de Medicina Veterinaria y Zootecnia. Universidad de San Carlos de Guatemala.

pp) Perla, F., L. A. Silva, G. Acosta M., F. de Moreno, L. R. McDowell, J. K. Loosli and J. H. Conrad. 1978. Mineral status of cattle in El Salvador. Abstracts, 70th Annual Meeting American Society of Animal Science. East Lansing, Michigan. p. 433.

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