AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
BATCH #16

1. SUBJECT CLASSIFICATION

A. PRIMARY
Serials

Y-AL00-5200-0000

B. SECONDARY
Agriculture--Animal production--Ruminants

2. TITLE AND SUBTITLE
Annual report: 1 July 1973 to 30 June 1974

3. AUTHOR(S)
(101) Tex.A&M Univ.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1974	159p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Tex.A&M

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(Research summary)

9. ABSTRACT

10. CONTROL NUMBER
PN-RAA- 795

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Animal husbandry
Livestock

13. PROJECT NUMBER

14. CONTRACT NUMBER
CSD-3675 211(d)

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

AID - 211(d) ANNUAL REPORT

1 July 1973 to 30 June 1974

to

U. S. AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D. C.

Grantee
TEXAS A&M UNIVERSITY

Institute of Tropical Veterinary Medicine & Department of Animal Science
College of Veterinary Medicine College of Agriculture

211(d) Annual Report
June 1974

Title: "Expanding Competence in the Design & Execution of Livestock Development Programs in the Tropics, Emphasizing Ruminant Livestock Production Systems Through Improved Breeding & Disease Control" AID/csd-3675

Grantee: Texas A&M University
College Station, Texas

1/2 to Institute of Tropical Veterinary Medicine,
College of Veterinary Medicine and
1/2 to Animal Science Department

This 1/2 of the report is for the Institute of Tropical Veterinary Medicine.

Director: Fred D. Maurer

A. Statistical Summary:

Period of Grant: 1 July 1972 to 30 June 1977
Amount of Grant: $250,000. to the ITVM, College of Veterinary Medicine

Expenditures: For current year 1973-1974, $31,490.00
Accumulated, $39,359.00
Anticipated for next year, $66,449.00

B. Narrative Summary:

Following several consortium meetings relative to a program of work in Guyana, and a lengthy period of negotiation with the Guyanese government a plan for animal health work in Guyana was accepted and is now underway during the May to August period of 1974. The detail of proposed research and study in Guyana is reported in Appendix IV of this report.

A course on the major infectious diseases which handicap livestock production in the Tropics has been developed and is outlined in Appendix II.

A library of information on Tropical diseases of food producing livestock has been accumulated. Likewise, an extensive collection of training aids in the form of colored slides and histologic slides has been accumulated. From this material a significant list of study sets with commentaries

have been prepared. These study sets and exchanges of training aid material are listed in Appendix I.

Our library of Tropical disease information has been considerably strengthened by the new information published by our own professional staff in the Institute of Tropical Veterinary Medicine. An accumulated list of staff publications with abstracts are listed in Appendix III.

We have had four graduate students receive some support from the grant this year. Two of these, Dr. Ken Thompson and Dr. Donald Corrier, have completed work for their Ph. D. degrees and have joined the Institute staff. Dr. Tom Craig and Dr. John Wyss will complete their Ph. D. degrees in January 1975. Dr. J. Wyss's research for his dissertation is outlined in Appendix V.

C. Detailed Report:

I. General Background and Purpose of the Grant

The World's human population is increasing more rapidly than its food supply by some 2% per year. World food production is presently inadequate in both quantity and quality. Food for the rapidly expanding population is a critical problem. Already, two-thirds of the World's children suffer from malnutrition owing to protein deficiency. The inclusion of a small amount of animal protein per day will provide the essentials for growth and nutrition so that the rest of the diet can be composed of whatever plant foods are available. Animal proteins are most readily consumed in adequate quantity even by children, following the processing available even in a primitive environment.

Some sixty-five percent of the World's land area produces range forages which will support ruminant animals while only eight percent is suitable for crop production. The potential for more efficient and more abundant livestock production is great in most regions of the world. The development of this potential requires improved animal nutrition, breeding, management and disease control. Our 211(d) Consortium was established for the development of competence in these special fields which are so vital to more efficient livestock production.

Our sphere of responsibility in the Consortium is in the field of animal health. Due to the high incidence of indigenous infectious and parasitic animal diseases in the developing countries of the Tropics, these diseases often constitute major handicaps to livestock production hence the food supply. For these reasons we consider the development of information and the training of people in the diagnosis, prevention, and control of these diseases to be our primary mission.

II. Objectives of the Grant

1. Objectives restated

To improve staff capability at Texas A&M University to design and conduct efficient disease prevention and control programs for ruminant livestock production in the Tropics. This objective to be attained through the provision of training and experience for staff personnel. The training to be accomplished through staff involvement in academic education, research and field application. Since efficient livestock production involves management, breeding, nutrition and economic considerations as well as disease control, this is a cooperative Consortium effort to develop all essential aspects of livestock production.

2. Review of objectives

The long delays in negotiations with Guyana made it impossible to activate the program in Guyana before the summer of 1974. This delay required us to put emphasis upon training of personnel.

Education in this specialty requires access to the current fund of knowledge in Tropical Veterinary Medicine. Since this involves exotic diseases which occur primarily in under-developed countries where research has been very limited, there are many unknowns requiring the application of modern research techniques. Such information as has been developed is widely scattered in the world literature.

It follows that prerequisite to an adequate training program must first come the accumulation of what is known about each significant livestock disease into a local accessible library and a research program for new information, as

1. A library of scientific research literature which we will keep current.
2. Training aids which will include colored slide transparencies for projection of clinical cases, of gross and histopathology, pathogenic organisms, and parasites.
3. Pathologic specimens, consisting of gross tissues,

histologic slides, blood smears and pathogenic organisms.

4. An active research program to develop a better knowledge of each disease.
5. A research program to develop and apply improved methods for diagnosis, treatment and prevention of each disease.
6. The development of a training program to convey available information to undergraduate professional students, graduate students, veterinarians and livestock producers.

III. Accomplishments in our 211(d) Program include the following:

1. A library of exotic disease is being developed at Texas A&M and at CIAT in Colombia.

2. A library of training aids is being developed. Study sets have been completed with commentaries on 13 diseases. Partial sets are available on 5 other diseases. Material for set preparation has been accumulated on many other diseases. Study sets and materials have been loaned and/or exchanged with some 23 other investigators in our efforts to accumulate this training aid material. See Appendix I, "Training Aids Prepared, Exchanged and Loaned Under 211(d) Program".

3. Academic Training. The formal academic training of graduate students is provided in the College of Veterinary Medicine for both U. S. and foreign veterinarians. M. S. and Ph.D. degree programs are presented in Veterinary Microbiology, Veterinary Pathology and Veterinary Parasitology, with their research being done in the Tropics.

During this reporting year, Dr. Tom Craig has been a graduate fellow supported by 211(d) funds working one-half time to help develop our Tropical disease library of literature and training aids, and to prepare for his four-month period of work in Guyana, from May to August 1974. Research for his Ph.D. dissertation involves a study and survey of major parasitic diseases which handicap cattle production in Guyana.

Dr. Kenneth Thompson was a graduate fellow on 211(d) funds from 1 September 1973 through December 1973, at which time he completed work for his Ph.D. and joined our AID/Colombia staff as a full time staff member. His dissertation is entitled, "A Comparison of the Antigenic Properties of Erythrocytes Babesia bigemina in acute and chronic Blood borne and Tick borne Infections in Cattle". A brief

abstract is included in Appendix III.

Although Dr. Don Corrier has not been on 211(d) funds since 1 July 1973, he has completed his Ph. D. program in this fiscal year which was partially supported by 211(d) funds in 1972-73. A brief abstract of Dr. Corrier's dissertation is included in Appendix III.

4. A 15 week, 3 credit hour, training course entitled, "Exotic and Tropical Diseases of Domestic Animals" No. 577, has been prepared as an elective for veterinary and graduate students. A copy of the course outline is attached. See Appendix II. Dr. K. Kuttler is the course instructor but all members of the Tropical Veterinary Medicine program will present lectures.

5. Informal training and continuing education. Such training has been accomplished by the faculty of the Institute of Tropical Veterinary Medicine as follows:

Miss Juliet Jagernaff was sent here from Guyana with WHO support for a 3 month's period to gain expertise as a serology technician in the laboratory diagnosis of animal diseases. She worked with our technicians primarily under the guidance of Dr. Kuttler in 1973.

A Mexican veterinarian, Dr. Lamberto Moro, spent a week in our Tropical disease laboratory learning to conduct C. F. tests for the diagnosis of hemoprotozoal diseases under Dr. Kuttler's guidance in January of 1974.

A Colombian veterinarian, Dr. Silvio Guzman from the CIAT Animal Health group spent two weeks being trained in laboratory techniques for hemoprotozoal diseases by Dr. Todorovic of our staff.

Our Institute of Tropical Veterinary Medicine (ITVM) staff in Palmira, Colombia, spends several days each January helping to put on a training course on beef production for Colombian personnel.

Dr. Maurer has been helping with the training of USDA veterinarians in exotic diseases as part of the national emergency disease program. He has given lectures on three subjects, i. e., the Disease Situation in the Tropics; African Horsesickness; and African Swine Fever & Hog Cholera. These seminars have been conducted at Nashville, Dallas, Indianapolis, Denver, and Reno during the first three months of 1974.

In January 1974, a one day cattle production, breeding

& disease control seminar was presented in Spanish to Latin veterinarians & livestock producers by 211(d) program personnel from Animal Breeding and Tropical Veterinary Medicine. This seminar will be repeated in April 1975.

Drs. Kuttler and Maurer presented lectures to a university class on Tropical agriculture.

Weekly seminars are held in the Tropical disease laboratories at Texas A&M to keep faculty & graduate students informed of all Institute activities & research progress.

6. Training through Consultation & Assistance on Tropical animal problems by the professional staff of the Institute of Tropical Veterinary Medicine:

Dr. Radmilo Todorovic participated in a seminar on hemoprotozoal diseases in Bogota, in July 1973.

Drs. Adams & McConnell presented lectures and demonstrations at a bat rabies diagnosis & control program in Panama City, in 1973.

Dr. John Wyss participated in a bat rabies seminar in Valle DuPar, Colombia, in August 1973, with Dr. McConnell.

Dr. Fred Maurer has been on a National Academy of Science committee for the past 3 years to report on livestock & disease research priorities for Africa. He spent 5 weeks visiting veterinary research laboratories in Africa collecting data. The report requested by USAID will be available in June, 1974.

Dr. Fred Maurér spent August of 1973 in West Pakistan at the request of USAID on a 4-man team to make recommendations for improving livestock production.

Drs. Maurer & Kuttler visited Guyana to help make plans for the 211(d) program there which will be carried out by Dr. Tom Craig during May to August, 1974. A report of their survey is covered in our 211(d) annual report of June 1973.

Dr. Tom Craig has been in consultation with Dr. Day of Haitti on animal health problems there.

Drs. Adams & Maurer participated in a meeting of Director of Institutes of Tropical Veterinary Medicine in Edinburgh, Scotland, in September 1973, where they made arrangements for and later accomplished several exchanges of training aids and information for mutual benefit. These exchanges are listed separately. Appendix I.

Dr. Ken Kuttler went to Nicaragua at the request of USAID in April 1974, to assist in the differentiation between rabies & hemoprotozoal diseases, etc. in cattle.

Dr. R. Todorovic was invited by the U. S. Air Force to visit the Marianas and assist in the premunition of some 700 head of cattle being imported from New Zealand. A copy of Dr. Todorovic's report is included as Appendix VI.

7. Faculty Exchanges to facilitate training:

Dr. Russel J. Rogers spent four months with our Institute of Tropical Veterinary Medicine staff at Texas A&M, from April to July 1973. He worked in the laboratory and participated in weekly seminars. Dr. Rogers was from the Animal Research Institute, Department of Primary Industries, Yeerongpilly, Brisbane, Australia 4105.

Dr. Yusuf Aliu from the faculty of veterinary medicine, Amido Bello, North Nigeria, has been a graduate student seeking a Ph.D. here at the College of Veterinary Medicine for the past two years and has done his research in our Institute of Tropical Veterinary Medicine.

8. Publications:

The faculty of the Institute of Tropical Veterinary Medicine has been active in publishing their work and some 68 publications have been made by the staff in the field of Tropical Veterinary Medicine. See Appendix III, Publications.

Expenditures Allocated to Accomplishments for period 1 July 1973 to 30 June 1974:

Expenses of Guyana program	
Travel and perdiem	$ 1,644.
Equipment	823.
Supplies & Operations	400.
Library & Publications	300.
Training Aids	
Supplies & Operations	2,634.
Equipment	391.
Information Exchange & Related Travel	3,505.
Graduate Assistantships	19,867.

IV. Impact of Grant Support Activities in Developing Institutional Capabilities:

It was only possible through the utilization of AID 211(d) funds that Dr. Adams and I were "able" to participate in a meeting of Directors of Institutes of Tropical Veterinary Medicine from around the world in Edinburgh, Scotland, in September 1973. There we not only had opportunity to become acquainted with the people involved and discuss problems of mutual concern but established many contacts of long range value to our AID programs. An outgrowth of these contacts was the exchange of information and some of the training aids listed in Appendix I.

This 211(d) grant has provided the opportunity for us to work up, into useful form, much of the potentially valuable training material accumulated in connection with our AID Colombia contract. By having a man available to do the work of developing a reference library and help in the preparation of study sets is a great help to the research staff who generate much of the basic material but lack time from their research to put it in the most useful form for training purposes. The combination of a 211(d) program with a closely related research contract has considerable advantage in this respect over either alone. Without the related research, the costs of accumulating information and materials for the 211(d) program would far exceed current 211(d) funding.

The increased availabilityof training aids and references has made possible the course in foreign animal diseases which in turn will be of major help in the training of students and staff.

The involvement of the staff in the preparation of training materials is a useful training exercise in itself for those of us involved.

These training materials will not only contribute to the knowledge of Texas A&M personnel and students, but will be utilized in consortium seminars for the benefit of the whole consortium.

The availability of this reference and training material which can be utilized by staff and students will save much time for the senior staff in being able to hand a student a package of material to study rather than spend hours answering questions and having to assemble pictures and reference material from their personal libraries and elsewhere.

Spinoffs from the competence développed by our personnel from the

training and experience received through this 211(d) grant and our AID/Colombia contract have enabled us to render considerable assistance on both domestic and foreign animal disease problems relating to livestock production.

At home, our staff has been much involved as consultants and coworkers in the problems associated with the invasion of southern Texas by Boophilus ticks which are vectors of Babesia argentina and B. bigemina. In this connection Dr. Kuttler has been doing some research in a USDA laboratory at Nuevo Laredo. The laboratory is now being moved to a Falcon Dam site where the work will continue if the USDA provides the animal holding facilities which they have indicated they desire to furnish for our use there. We have also submitted proposals to the Texas Agriculture Experiment Station and the USDA for a tick isolation facility at Texas A&M, and for research support for this work.

V. Utilization of Institutional Resources in Development

As noted under accomplishments, every staff member has been called upon by USAID or other Federal agencies to assist during the year in some foreign program apart from the 211(d) and AID/Colombia contracts. Drs. Kuttler, Adams, and Wyss have taken part in the AID bat-rabies program in Nicaragua, Panama, and Colombia, and Dr. Thompson will soon be going to Equador to collect and study related bovine blood samples. Dr. Todorovic has recently spent about three weeks in Saipan and Guam, for the Department of the Interior, helping control hemoparasitic infections in imported cattle. Dr. Maurer spent the month of August on livestock health & production problems for USAID in West Pakistan. He has also been serving on a National Academy Committee to appraise research priorities for animal production in Africa for USAID. Dr. Craig, while assigned to work in Guyana this summer, has been asked to take part in a training seminar on hemoprotozoan diseases at the University in Port of Spain, Trinidad.

Under accomplishments, foreign students, visiting technicians, and veterinarians have been listed who have been at our laboratory for various periods of training from a few days to the full year. All of the senior members of our staff in Tropical Veterinary Medicine have continuously served as chairmen or members of graduate committees for both foreign and domestic students working on programs in or closely related to Tropical Veterinary Medicine.

211(d) and AID/Colombia projects combined have contributed some 70 publications which contribute to the fund of knowledge in Tropical Veterinary Medicine thereby contributing to more efficient livestock production.

VI. Other Resources for Grant Related Activities:

Texas A&M University has provided all physical facilities, offices,

laboratories, libraries, animal quarters, utilities, and many items of equipment for both the 211(d) and AID/Colombia programs. Less tangible has been the free cooperation, consultation, and training offered our staff and graduate students by the University, and especially the Veterinary faculty. It would not have been possible for us to offer degree training through our 211(d) grant if we had not had close cooperation and excellent support from Dr. L. Grumbles, head of Veterinary Microbiology; Dr. C. Bridges, head of Veterinary Pathology, and Dr. R. Bell, head of Veterinary Parasitology, and their faculties. Dr. Bell, for example, with considerable sacrifice, gave up Dr. Tom Galvin for a two year period while he has worked in our AID/Colombia project in Colombia. Dr. Grumbles and Dr. Bridges have been willing to pay one-half salaries of Drs. Kuttler, Todorovic, and Adams while they have worked in Tropical Veterinary Medicine. Further, Dr. Grumbles has supported Drs. R. Hidalgo and Stuart McConnell to work on anaplasmosis and other cattle diseases in close cooperation with our staff in Tropical Veterinary Medicine.

We were enabled to utilize General Research Support Grant funds provided to the College of Veterinary Medicine from NIH in the amount of $4,700. for support of research in Tropical Veterinary Medicine, and $1,125. of like funds to employ a student laboratory assistant. In like manner, we were enabled to use $3,200. of University Research funds to provide some technical help for Dr. Adams.

The Veterinary College Photography laboratory has been of major assistance in the preparation of training aids at no cost for labor or equipment involved which has been considerable.

The College of Veterinary Medicine has provided Dr. Maurer's full salary and that of his secretary since the inception of our AID supported program in 1968, and 211(d) in 1972, during which time Dr. Maurer has devoted at least one-fourth of his time to these AID programs.

One of our graduate student Ph.D. candidates was fully supported for two years by the Department of Veterinary Parasitology prior to any support from 211(d).

VII. Next Year's Plan of Work and Anticipated Expenditures:

The work which Dr. Craig initiated in mid-May in Guyana will extend into July and August of the next Fiscal Year for 211(d). Based upon our best estimates, those expenditures will be as follows:

Travel & Perdiem	$ 2,000.
Technical Assistance	1,000.
Supplies & Operations	500.
The costs of working up the specimens and illustrations Dr. Craig will bring back to Texas is estimated at	$1,000.
	$4,500.

The development of our library of information on foreign animal diseases and of our library of training aids will continue and Dr. Maurer will be free to devote much more time to the accumulation and development of training material than previously. In addition, to utilizing accumulated illustrations and developing them into finished study sets with commentaries, Dr. Maurer plans to visit the Armed Forces Institute of Pathology and the USDA Emergency Disease Program Center, both of which are in the Washington, D. C. area and from them to obtain copies of pictures which can be added to our collection for the preparation of study sets. In addition, we will grasp any opportunities such as arise during any foreign travel to obtain information or illustrations on foreign diseases of significance. There are some important diseases for which adequate illustrations are not available in the U. S. and for which foreign travel will be required to obtain them unless they can be obtained through exchange with foreign workers. Unfortunately, illustrations obtained through exchange are not always of as good a quality as we can take ourselves. It is estimated that the travel expense incident to this work will be roughly $4,000. The film and related processing and equipment will likely cost about $1,500.

During 1 July 1974 to 30 June 1975, the following personnel expenses are anticipated:

Dr. Tom Craig will continue on his Ph.D. degree program 1 July through 30 December 1974, i.e., for six months	$ 4,500.
Dr. John Wyss will continue on his Ph.D. degree program 1 July 1974 through 30 December 1974,	4,500.
Dr. Tom Craig is expected to be added to the program in January 1975, at $8,831. + $605. allowances for six months	9,436
Effective 1 September 1974, 3/4ths of Dr. Maurer's salary for ten months, $18,750 + $978. for allowances will be paid from 211(d) funds	19,728.

Planned Workshops & Seminars:

In the fall of 1974, a hemoprotozoal workshop is being planned to be held at CIAT in Colombia, to which outstanding world authorities on hemoprotozoa will be invited.

A training seminar for Latin livestock producers will be conducted at Texas A&M in April 1975, similar to the one held in January 1974.

An on-the-job training program is planned for the training of several Brazilian DVM faculty members in Colombia in the

fall and winter of 1974. This will probably be followed by our participation in a training program and demonstrations in the operation of a premunition center in southern Brazil.

Following a May 1974 visit by 211(d) consortium representatives to several West African countries, a seminar for African veterinarians and livestock people is planned for the fall of 1974, to demonstrate U. S. methods of ranching, animal husbandry and disease control in the range country of the southwestern U. S.

211-D BUDGET

1 July 1974 to 30 June 1975

Salaries		Fringe Benefits: S. Sec.	Unemp.	WC
Fred Maurer, 3/4 - 10 mos.	$ 18,750.	$ 737.10	$ 52.50	$ 75.00
Research Assoc. - 6 mos.	8,831.	517.00	52.50	35.00
Secretary - 10 mos.	5,760.	336.96	52.50	23.04
Clerical	1,926.			
	35,267	1,591.06	157.50	133.04
			TOTALS	$37,148.60

Graduate Assistantships		
Tom Craig @$750/mo - 6 mos.	4,500.	
John Wyss @$750/mo - 6 mos.	4,500.	9,000.00
Travel		12,000.00
Equipment		3,000.00
Library		300.00
Supplies		5,000.00
		$ 66,449.60

Fringe Benefit Rates:
Soc. Sec. 5.85% of first $12,600.
Unemp. Ins. 1.25% of first 4,200.
WC .004% of Total salary

EXPENDITURES:

1972-73	1/7/73-1/6/74	Estimated 1974-75
$8,697.00	$31,490.00	$ 64,533.00

Table I

Distribution of 211d Grant Funds and Contributions From Other Sources of Funding*

Review Period 1 July 1973 to 30 June 1974

(List all grant related activities)	211d Expenditures				Non 211d Funding Amount for '73-'74
	Period Under Review 73-74	Cumulative Total	Projected Next Year 1974-75	Projected to end of Grant	
e.g. Research, GUYANA	2,867.	2,867.	4,500.	9,000.	$360,000. - AID-Colombia Program
Teaching		237.	500.	1,000.	
Libraries					
Information	300.	447.	500.	1,000.	free consultation provided by staff of Trop. Vet. Med. & College of Vet. Med.
Training Aids					secretarial help
Supplies	2,634.	3,001.	3,000.	6,000.	
Equipment	391.	853.	3,000.	2,000.	$8,000. Photo equipment $4,325. Technician's salary
Travel & Info. Exch	3,505.	3,505.	12,000.	21,000.	$4,700. Research support from University
Graduate Asst.	19,867.	22,541.	9,000.	27,000.	$17,954. Related drug research - commercial grant & Univ. $150,000. State provided labs and animal facilities $ 16,000. personnel (estimate)

* These figures are your best estimates

Table II

(Actual & Projected)

Under Institutional Grant #AID/csd-211d 3675
Review Period 1 July 1972-30 June 1973

(Lines Items to Conform to Budget in Grant Document)	Expenditures to date '73-'74 Period Under Review	Cumulative Total 72-74	Projected Expenditures '74-'75 2	'75-'76 3	'76-'77 4		Total Budget
e.g. Salaries	$ 1,926.	$ 3,406.	$ 37,149.	$ 40,100.	$ 42,827.		$ 123,482.
Travel	5,149.	7,956.	12,000.	11,000.	10,000.		40,956.
Equipment	1,213.	1,450.	3,000.	1,000.	1,000.		6,450.
Other:							
Teaching							
Libraries	300.	328.	300.	200.	200.		1,028.
Publications							
Supplies	3,034.	3,677.	5,000.	5,000.	5,865.		19,542.
Graduate Assistant-ships	19,867.	22,542.	9,000.	18,000.	9,000.		58,542.
	$31,490.	$39,359.	$ 66,449.	$ 75,300.	$ 68,892.		$ 250,000.

ITVM FACULTY & GRADUATE STUDENTS

TEXAS

FACULTY:

Fred D. Maurer, Director; D.V.M., Ph.D.
Kenneth L. Kuttler, Associate Director; D. V. M., Ph.D.
Radmilo A. Todorovic, D.V.M., Ph.D.
L. Gary Adams, D.V.M., Ph.D.

GRADUATE STUDENTS:

Thomas M. Craig, D.V.M., 211-d. *
John Wyss, D. V. M.; 211-d. *
Tom Kyzar, D.V.M.; Army.
Sonny D. Reynolds, D.V.M.; Army.

COLOMBIA

FACULTY:

Thomas J. Galvin, D.V.M., Ph.D.; Project Leader.
Donald E. Corrier, D.V.M.
Kenneth C. Thompson, D.V.M., Ph.D.
Dave Hopps, D.V.M., Research Assistant

* Drs. Craig & Wyss are the only members of staff or students currently funded by 211(d). They are due to complete their training in January 1975

APPENDIX I

I

Training Aids Prepared, Exchanged & Loaned Under 211D Program

These refer to Kodachrome colored transparencies which illustrate the clinical, gross & histopathology of a variety of Tropical diseases.

We have prepared study sets with commentaries on the following Tropical diseases. In most instances these are also accompanied by research papers describing the pathology.

Rinderpest (R)
- Set - 78 Kodachrome slides with commentaries & research paper.
- Set - 40 " " " " " " " "

African Horsesickness (AHS)
- Set - 110 Kodachrome slides with commentaries & research paper.
- Set - 40 " " " " " " "

African Swine Fever (ASF)
- Set - 62 Kodachrome slides with commentaries & research paper.

Hog Cholera (HC)
- Set -54 Kodachromes with commentaries & paper

Sets of blood smears from cases of
- Bovine babesiosis
- Bovine anaplasmosis
- Bovine theileriosis
- Bovine trypanosomiasis

Sets of colored slides on
- Bluetongue of White Tailed deer, big horned sheep, sheep & cattle
- Theileria cervi in White Tailed deer
- Anaplasmosis in White Tailed deer
- Babesiosis in White Tailed deer
- Eperythozoon in White Tailed deer

Partial Sets of:
- Dermatophalosis
- East Coast Fever
- Babesiosis in cattle
- Anaplasmosis in cattle
- Foot & Mouth disease in cattle, sheep, and swine

We have loaned or provided slides on an exchange basis with the following people and institutions:

To Colonel G. Trevino, USDA Emergencies Disease Program:
Provided sets with commentaries & papers on R, AHS, ASF, HC.

To Colonel Guy G. Moran, Vet. Sci. Div., Academy of Health Sciences, US Army, Ft. Sam Houston, Texas:
Complete sets of R, AHS, ASF, and HC.

To Dr. E. Weiss, Dir. Veterinar Pathologisches Institut Justus-Liedig Universitat, Frankfurterstrasse 94, Giessen 63, W. Germany

Provided: Bluetongue in sheep
Hog Cholera
Rinderpest
African Swine Fever
African Horsesickness

Received: Bovine Petechial Fever
Foot & Mouth Disease
Rift Valley Fever
Malignant Catarrhal Fever
East Coast Fever
Maedi

To Prof. Dr. H. Stunzi, Direktor Institut fu Veterinar-Pathologie, Universitat Zurich, Winterthurerstrasse 260, Zurich, Switzerland 8057

Provided: Bluetongue in sheep
Bluetongue in deer
Hog Cholera
Rinderpest
African Swine Fever

Received: Swine Vesicular Disease
Kriebel mucken (Bovine mammilitis due to Simuliidae)
Trypanosomiasis

To Prof. Dr. I. D. Schultz, Firektor Institutes fur Pathologie, Tierarztliche Hochschule Hannover, Hans-Bockler, Allee 16, Hannover, Niedersachen, W. Germany

Provided: Rinderpest
African Horsesickness
African Swine Fever
Hog Cholera
Bluetongue in sheep

Received: Tuberculosis
Glanders
Bovine Papillary Stomatitis
Foot & Mouth Disease
Maedi

To Drs. Smit & Vanderwalt, Faculty of Veterinary Medicine, Onderstepoort, South Africa:
Two sets of 40 Kodachromes each with commentaries & paper on AHS
Two sets of R & Bluetongue

Obtained from Dr. Neitz, Faculty of Veterinary Medicine, Onderstepoort, South Africa:
A set of blood smear slides on hemoprotozoal diseases

Sent to Armed Forces Institute of Pathology and to CIAT, Colombia:
Anaplasmosis in White Tailed deer, sheep & cattle
Eperythrozoon in White Tailed deer, sheep & cattle
Theileria cervi in White Tailed deer
Babesia in White Tailed deer

Also wet tissues on Bluetongue in deer & big horn sheep

To Dr. Don Roberts, CIAT, Colombia
Study sets with commentaries on
Bluetongue in deer
Bluetongue in sheep
Babesia in deer
Theileria in deer
AH, ASF, HC, Rinderpest and
Dr. H. Smith's Path. slides, about 200 Kodachromes.

To Dr. Jardin, M. D. Anderson Hospital:
Blood films, wet tissues, impression smears, of ML in deer, along with case history

To The College of Veterinary Medicine, Lima, Peru:
Microscopic slides of
Anaplasmosis in White Tailed deer
Theileria in White Tailed deer
Babesia in White Tailed deer
Eperithrozoon in White Tailed deer and sheep & cattle

To Dr. Garner in England:
Slides of Plasmodium in White Tailed deer

To Prof. Dr. D. Zwart, Direktor Institut voor Tropische en Protozoaire Ziekten der Rijks Universiteit, Faculteit der Diergeneeskunde, Biltstraat 172, Utrecht, Netherlands

Provided: Rinderpest
Bluetongue in sheep
Bluetongue in deer
Hog Cholera
African Horsesickness

Received: Bovine Theilerosis
Bovine Babesiosis
Bovine Eperythrozoonosis
Bovine Trypanosomiasis
Toxoplasmosis
Contagious Bovine Pleuropneumonia
Porcine Trypanosomiasis

To Prof. Ian McIntyre, Dean, Dept. of Veterinary Medicine, University of Glasgow, Veterinary Hospital, Bearsden Road, Bearsden, Glasgow, G611QH, Scotland

Provided: African Horsesickness
Rinderpest
Hog Cholera
Bluetongue in sheep

Received: East Coast Fever
Fog Fever
Bronchiolitis Obliterans
Bovine Atypical Penumonia
Maedi

To Prof. Sir Alexander Robertson, Director, Centre for Tropical Veterinary Medicine, Royal (Dick) School of Veterinary Studies, University of Edinburgh, Easterbush, Roslin, Midlothian, Scotland

Provided: African Horsesickness
Bluetongue in sheep
Bluetongue in deer
Hog Cholera
African Swine Fever
Rinderpest

Received: Bovine Trypanosomiasis
Bovine Babesiosis
Breeds of Cattle
Malignant Catarrhal Fever
Rinderpest
East Coast Fever
Nairobi Sheep Disease

To Dr. J. Pagot, Institute of Tropical Veterinary Medicine, Alfot, France

Provided: Complete sets on R, AHS, ASF, and HC

They furnished us with colored slides of contagious Bovine

Pleuropneumonia, Pasteurella Septicemique des grande ruminants (HS) & Dermatophilose contagieuse des bovides.

To Dr. Howard Binns, Center for International Programs, Univ. of Guelph, Ontario, Canada
Provided: 40 R with commentaries & paper
40 AHS with commentaries & paper
62 ASF with commentaries & paper

To Dr. Peter Nderito, College of Veterinary Medicine, Kabeto, Kenya, East Africa
Provided: Sets of AHS and R with commentaries & paper
Sets of slides on Bluetongue in sheep & in cattle
Received: East Coast Fever slides

To Dr. J. H. L. Mills, Dept. of Pathology, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada
Provided: Set of R with commentaries & paper
Received: Set Malignant Catarrhal Fever

To Dr. John Huff, Dept. of Microbiology, Texas A&M University, College of Veterinary Medicine
Provided: Sets AHS with commentaries & paper
ASF " " " "
Bluetongue in sheep & deer w/ comm. & paper
Rinderpest " " " "

From: Dr. G. Wegner, East African Veterinary Research Organization, Muguga, Kabete, Kenya
Color transparencies of East Coast Fever

From: Dr. H. E. Metcalf, USDA Animal Disease Research Laboratory, Denver, Colorado
Color slides of Bluetongue in sheep & in cattle

APPENDIX II

Department: Veterinary Microbiology Course Number 577

Course Title: Exotic and Tropical Diseases of Domestic Animals

Complete Course Outline

Theory

Order of Presentation	Subject	Instructor	Est. Hours
1.	Introduction		
	(a) Introduction and Orientation of the Problems	Instructor	2
	(b) Influence of Foreign Animal Disease on World Livestock Production	F. D. Maurer*	1
2.	Hemotropic Diseases		
	(a) Anaplasmosis as it Occurs Overseas	Instructor	2
	(b) Babesiosis	R. A. Todorovic*	2
	(c) Trypanosomiasis	Instructor	4
	(d) Theileriosis	Instructor	3
3.	Viral Diseases		
	(a) Rinderpest	F. D. Maurer*	2
	(b) Foot & Mouth Disease	S. McConnell*	3
	(c) African Swine Fever	F. D. Maurer*	3
	(d) Venezuelan Equine Encephalitis	S. McConnell*	2
	(e) Rift Valley Fever	Instructor	
	(f) Lumpy Skin Disease	"	
	(g) Ephemeral Fever	"	
	(h) Malignant Catarrhal Fever	"	7
	(i) Louping Ill.	"	
	(j) Nairobi Sheep Disease	"	
	(k) Teschens Disease	"	
	(l) Epivaginitis	"	
	(m) African Horsesickness	F. D. Maurer*	1
4.	Other Diseases		
	(a) Contagious Bovine Pleural Pneumonia	Instructor	2
	(b) Heart Water	"	1
	(c) Streptothrichosis	"	1
	(d) Besnoitiosis	R. M. McCully*	1
	(e) Exotic Diseases of Wildlife Transmissible to Domestic Stock	R. M. McCully*	2
5.	The Threat of Foreign Animal Diseases to the U. S.	F. D. Maurer*	2

Order of Presentation	Subject	Instructor	Est. Hours
6.	The Epidemiology - Surveillance & Reporting Procedures for Foreign Animal Diseases	Guest Lecturer	1
7.	Major Examinations		3
		TOTAL	45

* Subject to confirmation.

Texts and References

1. Foreign Animal Diseases, Committee on Foreign Animal Diseases of the Revised 1964 and the same publication to be revised in 1973 - when it becomes available.

2. Henning, M. W.: Animal Diseases in South Africa, Third Edition, Central News Agency, Ltc., South Africa, 1956.

3. Gibbons, W. J., E. J. Catcott, & J. F. Smithcors: Bovine Medicine and Surgery, First Edition, 1970, American Veterinary Publications, Inc.

4. Other related publications including current scientific literature.

DEPARTMENTAL REQUEST FOR NEW UNDERGRADUATE COURSE

To the Curriculum Committee: Date: July 24, 1972

I request the approval of the following new course in the Department of Veterinary Microbiology to be offered beginning Spring 1973.

1. Proposed course number 599, Descriptive Title Exotic and Tropical Diseases of Domestic Animals.

2. Number of hours a week: Theory 3; laboratory _____; Credit Value 3

3. Indicate by I, II, or S whether this course is to be offered in the fall, spring, or summer III (Trimester).

4. Description of course (not more than 50 words). The Major foreign infectious diseases of food producing animals will be described with emphasis on the etiologic agent, transmission, pathogenesis, diagnosis, treatment and control. The epidemiologic aspects and possible threat to U. S. livestock will be considered.

5. Prerequisites: Two Years of Veterinary Curriculum

6. Proposed Instructor: K. L. Kuttler and Selected Staff

7. For what group of students is this course planned? Third Year Veterinary Students.

8. Is it to be elective or required? Elective.

9. Estimate number of students who will enroll in this course. 18

10. Average size of classes of this rank offered by the Department this year. None offered

11. Is there a similar course offered in any other department in the College? No. If so, identify. _____

12. Additional comments: This course is intended to fulfill two purposes, first, to acquaint the future large animal practitioner or regulatory veterinarian with foreign animal diseases which might accidentally be introduced into this country. Prompt recognition of these conditions would facilitate more rapid control and eradication. Secondly, there is a constantly increasing need for qualified veterinarians to assist in animal disease control programs in lesser developed countries, where disease problems often play a major role in livestock production. This course should provide the orientation and basis needed for future study should an overseas career be the goal or possible ambition of the veterinary student.

Approval Recommended:

_____ Dean of School

_____ Head of Department

Approved by the Curriculum Committee on

_____ Chairman of Curriculum Committee

APPENDIX III

KUTTLER, K. L., ZARAZA, H. and ROBERTS, E. D.: Hematologic and Clinical Response to Anaplasmosis Vaccines and the Comparative Efficacy of These Vaccines, As Measured by Field and Experimental Challenge. Proceedings of the 5th National Anaplasmosis Conference, February 28-29, 1968, Stillwater, Oklahoma, 39-49.

Twenty, 3-month-old calves were divided in 4 equal groups. Group 1 was inoculated with an attenuated Anaplasma marginale, group 2 received an A. marginale adjuvant vaccine, group 3 was infected with virulent A. marginale followed by treatment, and group 4 remained as unvaccinated controls. All animals were moved into an Anaplasma endemic zone 3 months later and allowed to undergo natural field challenge. Evidence of acute anaplasmosis was observed in all calves, except those premunized by virulent A. marginale. No significant evidence of protection was produced by either the attenuated A. marginale or the adjuvant vaccine when compared to the unvaccinated controls. The group premunized with virulent A. marginale failed to respond to natural exposure.

Hematologic response to virulent, attenuated, and killed A. marginale vaccines was measured in 18 mature cattle divided into 3 groups. The group receiving virulent A. marginale was treated 25 days after infection (Burroughs Wellcome Compound 356C61). No death losses occurred in this group, but moderate infections were observed to result in a significant reduction in PCV. The attenuated A. marginale vaccine produced a low level parasitemia, a marked serological response as measured by the complement-fixation (CF) test, and a very slight drop in PCV, which was not significantly different from values observed in an unvaccinated, non-infected, control group. The group receiving adjuvant vaccine showed only a low level, transient, CF serological response.

An experimental challenge was administered 8 weeks after vaccination to cattle receiving the attenuated and adjuvant vaccines along with a group of 5 unvaccinated controls. All controls reacted to challenge with severe acute signs of anaplasmosis. One animal was allowed to die; a second would probably have died had it not been treated. Cattle receiving the attenuated vaccine showed no signs of active infection resulting from challenge. Cattle receiving the adjuvant vaccine reacted to challenge, but less severely than did the controls.

ZARAZA, H. and KUTTLER, K. L.: Respuesta Hematologica y Clinica a Diferentes Vacunas de Anaplasmosis y la Eficacia Comparative de estas, Evaluadas por la Inoculacion Experimental. Revista ICA, (December 1968), 3, (4): 323-331. (Spanish translation of above.)

BISHOP, J. P. and KUTTLER, K. L.: Infectivity and Immunogenicity of Irradiated *Babesia rodhaini*. Journal of Protozoology (submitted).

Babesia rodhaini parasitized mouse blood exposed to varied doses of gamma radiation up to 30,000 r was inoculated into mice. Mice inoculated with non-irradiated *B. rodhaini* developed progressive infections and died 7 to 11 days after inoculation. Mice infected with *B. rodhaini* parasitized blood exposed to doses up to and including 22,000 r developed progressive parasitemias which were delayed in comparison to mice inoculated with nonirradiated *B. rodhaini*. Some mice receiving parasitized blood irradiated at 26,000 r did not develop progressive parasitemias. Progressive infections were prevented by exposure to irradiation at 30,000 r.

The results of two separate experiments revealed that one inoculation of parasitized blood exposed to 30,000 r or higher apparently stimulated a resistance to a challenge infection with nonirradiated parasitized blood. While 20 out of 20 control mice died as a result of challenging infections, 9 out of 28 mice previously exposed to irradiated parasitized blood survived.

The injection of irradiated nonparasitized blood did not produce a discernable acquired resistance to *B. rodhaini*. Presumably the irradiated parasitized blood was responsible for the development of acquired resistance to *B. rodhaini*.

CARSON, C. A.: An Antigenic and Serologic Comparison of Two Virulent Strains and an Attenuated Strain of *Anaplasma marginale*. A Thesis submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Master of Science, August 1969.

An antigenic and serologic study was conducted using virulent strains of *Anaplasma marginale* from Texas and Colombia and an attenuated strain of *Anaplasma marginale*. Soluble antigens of the three *A. marginale* strains were compared by agar gel diffusion and immunoelectrophoresis. Serum proteins from calves infected with each of the three *A. marginale* strains were separated electrophoretically and reacted with rabbit anti-bovine serum in immunoelectrophoresis systems.

No differences between the soluble antigens of the three *A. marginale* isolates were detectable by agar gel diffusion. All three antigens moved to the same mobility zone in agar gel electrophoresis systems and each antigen formed an arc of precipitation when reacted with serum from calves infected with homologous or heterologous strains of *A. marginale*.

A *beta* and a *gamma* serum protein component, not exhibited in normal bovine serum, were present in the serums of animals infected with either of the virulent *A. marginale* strains or the attenuated strain.

CORRY, G. L. and KUTTLER, K. L.: Serological Activity of a Soluble Antigen of Theileria cervi. Experimental Parasitology (submitted).

Two basic cellular erythrocytic antigens were prepared from erythrocytes obtained from a white-tailed deer (Odocoileus virginianus) infected with Theileria cervi. The first antigen was prepared from erythrocytes lysed by freezing, the second from erythrocytes lysed with distilled water. The serologic activity as determined by the complement-fixation (CF) test was greater in the antigen lysed by freezing. Both antigens when solubilized at pH 7.2 using ultrasonic disintegration increased markedly in titer.

The two antigens were pooled and disrupted by ultrasonic disintegration in buffered mediums, ranging from pH 5 to pH 11. Optimal solubilization and serologic activity as measured with the CF test was obtained at pH 11.

The antigen solubilized at pH 11 was used to determine antibody in sera from infected deer by (CF) and by passive hemagglutination (PHA) tests. Both tests resulted in similar but not identical antibody titers.

A gel diffusion test and a ring (interfacial) test gave no valid results.

INDEX DESCRIPTORS: Theileria cervi effect of soluble antigen on complement-fixation and passive hemagglutination.

Theileria cervi is a hemoparasite of the white-tailed deer (Odocoileus virginianus), first described by Schaeffler (1961). It was thought by Marburger and Thomas (1965) and Robinson et al. (1967) to be a contributing factor of death losses among deer in Texas.

Other organisms of the same genus occur in different parts of the world where they cause diseases of varying severity in domestic and wild animals.

Laboratory diagnosis of these diseases depends primarily on microscopic detection of the parasites in stained smears. Serologic tests have been described by Schaeffler (1963), Kuttler and Robinson (1967), Kuttler et al. (1967), and Gadir et al. (1970). The antigens used in these tests were, for the most part, particulate. In this state, the cell membrane is most responsible for antigenic and serologic activity with the internal structure of the parasite cell not so greatly involved. It is not unreasonable to assume that the cytoplasm of the parasite cells contains a mosaic of antigens which when dispersed in molecular phase, i.e., when in solution, are capable of more specific or sensitive reactions. Such antigens could find wide use in serologic tests, and possibly prove of greater value in elucidating the antigenic relationship of similar intraerythrocytic parasites.

The purpose of this work, therefore, was to investigate the possibility of establishing a method of obtaining a soluble antigen from the erythrocytic stage of T. cervi that would react with the homologous antibody in an in vitro system.

KUTTLER, K. L.: Serial Passage of an Attenuated Anaplasma marginale in Splenectomized Calves. Proceedings of the 73rd Annual Meeting of the USAHA, October 12-17, 1969, Milwaukee, Wisconsin, 131-135.

Twelve serial passages of an attenuated Anaplasma marginale were made in splenectomized calves by blood inoculation. The severity of infection produced at the twelfth passage level in 4 splenectomized calves was compared to the infection occurring in 4 similar calves at a second passage level. Significantly higher parasitemias and lower packed cell volumes occurred in the twelfth passage group, suggesting an increased virulence. No deaths occurred among animals of the second passage group; whereas, 1 of 4 died in the twelfth passage group.

KUTTLER, K. L., ADAMS, L. G. and ZARAZA, H.: An Epidemiologic and Geographic Survey of Anaplasma marginale and Trypanosoma theileri in Colombia. 106th Annual AVMA Convention, July 1969, Minneapolis, Minnesota. Journal of the American Veterinary Medical Association, (June 1, 1969), 154: 1398, (abstract).

Anaplasmosis complement-fixation tests, packed cell volumes, and stained blood smears were made on 603 cattle located at 5 experiment station farms in Colombia. These farms were situated in differing climatic zones varying from 2,600 meters to 13 meters in altitude and from 13°C to 28°C in mean temperature. Specific reference was made to breed susceptibility, the influence of age, and climatic condition on the incidence and severity of infection.

A direct correlation was noted between mean temperature and incidence of anaplasmosis. At 13°C the incidence was nil; whereas, at 28°C over 90% infection was noted. The mean temperature is directly associated with altitude.

Incidence of infection in enzootic areas was generally greater in older animals, but the effect of infection as characterized by anemia was more noticeable in young animals. The incidence of anaplasmosis in European breeds did not appear greatly different when compared to native and Zebu cattle, but in some instances PCVs were significantly lower in European breeds. This was most marked at the lower elevations.

Blood cultures for T. theileri from 71 cattle at 2 experiment stations resulted in a pattern of infection similar to anaplasmosis. A high incidence of infection was noted at the lower elevation with a high mean temperature and no evidence of infection at 2,600 meters with a low mean temperature.

KUTTLER, K. L. and ZARAZA, H.: Premunization With An Attenuated Anaplasma marginale. Proceedings of the 73rd Annual Meeting of the USAHA, October 12-17, 1969, Milwaukee, Wisconsin, 104-112.

An attenuated Anaplasma marginale infection has been established in 21 calves and 12 mature cattle. The resulting infections were found to be significantly less severe than virulent A. marginale in 12 calves and 5 mature cattle. A slightly milder response to the attenuated A. marginale occurred in calves at Bogota with a mean temperature of 14°C when compared to calves similarly infected at Palmira with a mean temperature of 24°C.

Calves and mature cattle previously premunized with the attenuated organism appeared to be immune to virulent challenge using a Texas isolate of A. marginale. Experimental and natural challenge with a Colombian isolate resulted in evidence of acute anaplasmosis in both vaccinated and non-vaccinated animals.

TODOROVIC, R. A., ADAMS, L. G. and ROBERTS, D. E.: A Study of Bovine Babesiosis in Colombia, South America. Proceedings of the 106th Annual AVMA Convention, July 1969, Minneapolis, Minnesota. Journal of the American Veterinary Medical Association, (June 1, 1969), 154: 1399, (abstract).

Our research program on bovine babesiosis is a part of the Institute of Tropical Veterinary Medicine, College of Veterinary Medicine, Texas A&M University, with the research program being sponsored by the Rockefeller Foundation and conducted at the Laboratorio de Investigaciones Medicas Veterinarias laboratories, Bogota, Colombia, in cooperation with the Instituto Colombiano Agropecuario. This research effort is directed mainly toward the study and control of bovine babesiosis and the training of Colombian veterinarians and graduate students involved in these research projects.

Although bovine babesiosis is eradicated in the United States, the disease still occurs in most of the world and is of great importance as a threat to livestock industry, especially in the tropical areas of Latin American countries. In Colombia, babesiosis was first described by Lleras (1908) and later recognized as a widely distributed disease, causing great losses in purebred dairy cattle imported into enzootic areas. At the present time the incidence of babesiosis in Colombia is difficult to estimate. The disease exists as a mixed infection of Babesia bigemina, Babesia argentina, and Babesia major, and the incidence of infection appears to be related to the occurrence and activity of the tick vectors at the various altitudes.

The experiments were carried out to identify the existing Babesia species occurring in Colombia by morphologic, immunoserologic, pathologic, and chemotherapeutic methods. The immunoserologic relationship of Babesia spp. and strains were studied by gel-double diffusion precipitation, immunoelectrophoresis, and fluorescent antibody techniques. Attempts were made to develop a sensitive and practical serologic test for the diagnosis of the latent Babesia infection. Several groups of intact and splenectomized calves were inoculated with various antigens isolated from the blood of cattle with acute babesiosis and the blood from patent carriers, respectively. Response to vaccination, premunition, and challenge by tick-borne Babesia was recorded. The results of these experiments were discussed.

ZARAZA, H., KUTTLER, K. L. and ROBERTS, E. D.: Efectos de la Descarga Natural de Anaplasma marginale en Terneros Vacunados y no Vacunados. Revista ICA, (September 1969), 4, (3). (Spanish translation of: Kuttler, K. L., Zaraza, H. and Roberts, E. D.: Hematologic and Clinical Response to Anaplasmosis Vaccines and the Comparative Efficacy of These Vaccines, As Measured by Field and Experimental Challenge.)

ADAMS, L. G., HIPOLITO, O., MORALES, H., GONGORA, S. and JONES, L. P.: Dermatofilosis Bovina (Estreptotricosis cutanea) en Colombia. Revista ICA, (March 1970), 5, (1): 3-16.

Four cases of bovine dermatophilosis were diagnosed in Cordoba, Colombia and confirmed by bacteriological culture methods. Macroscopic and microscopic descriptions were made of the lesions caused by Dermatophilus congolensis.

S, L. G. and KUTTLER, K. L.: Toxicity of Alpha-Ethoxyethylglyoxal Dithiosemicarbazone in Cattle. American Journal of Veterinary Research, (August 1970), 31: 1493-1495.

Alpha-ethoxyethylglyoxal dithiosemicarbazone, administered 10 consecutive days at the dose rate of 5 mg/kg/day, caused axonal and myelin degeneration of the vagus nerve in 2 of 7 calves. Of the 7 experimental calves, 6 died of tympanites.

ADAMS, L. G. and TODOROVIC, R. A.: A Study of the Pathogenesis of Anaplasmosis in Intact Calves: Including Clinical, Clinical Pathological, Serological, and Immunofluorescent Techniques. Proceedings of the VI Congreso Panamericano de Medicina Veterinaria y Zootecnia, September 28 - October 3, 1970, Santiago de Chile, 37.

Twelve, 4-month-old, male, hemotropic disease-free, Holstein calves were inoculated subcutaneously with blood containing a Colombian isolate of Anaplasma marginale. Previous to inoculation 3 control samples were taken for bone marrow and blood determination.

Thereafter, samples were collected every 2 days and one calf was euthanatized every 2 days to collect a complete set of tissues for gross and microscopic pathological lesions as well as for the immunofluorescent study using the indirect technique. Results obtained are discussed, except those related to immunofluorescent study.

CARSON, C. A., ADAMS, L. G. and TODOROVIC, R. A.: An Antigenic and Serologic Comparison of Two Virulent Strains and an Attenuated Strain of Anaplasma marginale. American Journal of Veterinary Research, (June 1970), 31, (6): 1071-1078.

Soluble antigens of 3 Anaplasma marginale strains were compared by agar gel diffusion and immunoelectrophoretic techniques. Serum proteins from calves infected with each of the 3 A. marginale strains were separated electrophoretically and tested with rabbit anti-bovine serum in immunoelectrophoretic systems. There was no detectable difference between the soluble antigens or the 3 A. marginale strains. A beta globulin arc, which was not detectable in normal bovine serum, was present in serum of acutely affected calves, and a gamma globulin arc was lengthened in the latter serum as compared with that in serum of normal calves.

KUTTLER, K. L. and ADAMS, L. G.: Comparative Efficacy of Oxytetracycline and a Dithiosemicarbazone in Eliminating Anaplasma marginale Infection in Splenectomized Calves. Research in Veterinary Science, (July 4, 1970), 2: 339-342.

Comparisons between oxytetracycline and a dithiosemicarbazone (356C61) were made in 11 splenectomized, Anaplasma marginale infected calves. Oxytetracycline was administered at the rate of 11 mg/kg intravenously (i.v.) for 5 and 10 consecutive days. Compound 356C61 was administered at the rate of 5 mg/kg i.v. for 5 and 10 consecutive days.

Compound 356C61 appeared to be relatively more effective in the treatment of anaplasmosis, as indicated by the relative increase in packed cell volume (PCV) following treatment, and by the apparent elimination of the carrier status in animals receiving the 10 daily treatments. Compound 356C61 administered daily for 10 consecutive days resulted in rumen atony, tympanites, and death.

KUTTLER, K. L., ADAMS, L. G. and ZARAZA, H.: Estudio Epizootiologico de Anaplasma marginale y de Trypanosoma theileri en Colombia. Revista ICA, (June 1970), 5, (2). (Spanish translation of: Kuttler, K. L., Adams, L. G. and Zaraza, H.: An Epidemiologic and Geographic Survey of Anaplasma marginale and Trypanosoma theileri in Colombia.)

KUTTLER, K. L. and ZARAZA, H.: A Preliminary Evaluation of a Dithiosemicarbazone for the Treatment of Anaplasmosis. Research in Veterinary Science, (July 4, 1970), 2: 334-338.

Trials were conducted on 3 splenectomized calves treated with a single intravenous (i.v.) inoculation of a dithiosemicarbazone (356C61) using 5 mg/kg, at different stages of induced anaplasmosis infection. When compared to an untreated control this compound was effective in reducing the severity of the infection. Hematological response was least severe in the animal receiving treatment before signs of parasitemia or a decrease in packed cell volume had occurred.

Treatment with compound 356C61 (5 mg/kg i.v.) of 5 splenectomized calves and 6 intact adult cattle early in the course of an artificially induced Anaplasma marginale infection prevented death loss and reduced the severity of the subsequent reaction when compared with non-treated controls.

TODOROVIC, R. A.: Babesiellosis Bovina en Australia. Revista de la Facultad de Medicina Veterinaria y de Zootecnia, (1970), 32, (1 & 2): 45-59.

Bovine babesiosis is still of great importance as a threat to the livestock industry in Australia. Due to the complexity of the epidemiology of this disease and other factors, the eradication of this hemoprotozoan malady is not possible at the present time.

The Commonwealth Scientific and Industrial Research Organization (CSIRO) is actively engaged in control and research on Babesia. Other research and teaching institutions involved in the same problem include: the University of Queensland; New South Wales, Department of Agriculture, Cattle Tick Research Station; Queensland State Department and Animal Health Station. All of these research projects on Babesia are sponsored mainly from the Government of Australia.

The Australian research workers have contributed more than a hundred scientific publications on the various areas of Babesia research; they are foremost in this field and the best trained in the world. The research laboratories are equipped with modern scientific tools, and staffed with well-trained technicians who successfully operate these instruments. The facilities are excellent and designed particularly for Babesia research. (Slides of these facilities are available for those who are interested.)

The experience from this visit and knowledge obtained through discussion with Australian scientists working on different research projects will be invaluable for organizing a similar research program on Babesia in Colombia, South America. Furthermore, the Australian scientists with whom I visited all realized the importance of our mission in South America and expressed their willingness to cooperate with us in any manner in the future. They will be able to come to Colombia and spend time on short or long-term assignments if funds are available.

TODOROVIC, R. A., ADAMS, L. G., VIZCAINO, O. G. and GONZALEZ, E. F.: Research and Control of Bovine Babesiosis in Colombia. Proceedings of the VI Congreso Panamericano de Medicina Veterinaria y Zootecnia, September 18 - October 3, 1970, Santiago de Chile, 36, (abstract).

Research was carried out to develop an effective program for the control of bovine babesiosis in Colombia.

Experiments were carried out at the Palmira Instituto Colombiano Agropecuario (ICA) experimental station in Valle del Cauca (altitude 1,000 meters) to produce co-infectious and sterile immunity against bovine babesiosis. Calves randomly selected were divided into four groups according to the experimental design used to evaluate the immunoserological responses to vaccination against babesiosis and tick-borne challenge. The degree of this immunity was determined by tick- and blood-borne challenge. The percentage of parasitemia (P), body temperature (T), and percentage of mortality (M) were used as the basis for comparing the reaction produced after vaccination and challenge. Experiments were conducted to evaluate the prophylaxis, therapy, effects, dosage, route of infection, toxicity, and response of the animals injected with a new Burroughs Wellcome babesiacidal drug No. 4A65.

On the basis of the observations made from these experiments, conclusions can be drawn that some degree of sterile immunity exists, besides the well-known co-infectious (premunition) immunity in Babesia infections. To understand the exact mechanism of this type of immunity, more work needs to be done. The degree of resistance and the duration of immunity in relationship to different environmental conditions, strain differences, and the pathogenicity of the Babesia spp., and the quality of tick-borne challenge need to be determined.

TODOROVIC, R. A., GONZALEZ, E. F. and ADAMS, L. G.: Immune Response of Cattle Vaccinated Against Babesiosis in Colombia, South America. Proceedings of the American Veterinary Medical Association and the American Association of Veterinary Parasitologists, June 22, 1970, Las Vegas, Nevada.

Attempts to produce co-infectious and sterile immunity in cattle against Babesia infections have been carried out by vaccinating animals with live or killed Babesia vaccines at Palmira, Valle del Cauca, Colombia (altitude 1,000 meters). Immune responses of the vaccinated animals were evaluated by several immunoserologic methods. The degree of resistance to tick-borne challenge (Boophilus microplus naturally infected with Babesia spp.) was determined by the percentage of recovery to normal parameters used in this study.

According to the experimental design used, a total of 110 animals were divided in 5 experimental groups to ascertain the immunologic responses. The first group consisted of 20 male, 85 kg, Holstein, 3-month-old calves which were premunized with Babesia bigemina, Babesia argentina, and 4 weeks later were exposed to tick-borne (Boophilus microplus) challenge. The second group consisted of 20 male, 95 kg, Holstein, 4-month-old calves subdivided into 4 groups and vaccinated with a killed Babesia vaccine derived from the erythrocytes and plasma, respectively, of animals acutely infected with Babesia bigemina and Babesia argentina. The animals were inoculated with vaccine with or without Bacto-Adjuvant Complete H 37 Ra. The third group of 40 male, 80 kg, Holstein, 3-month-old calves was divided into sub-groups. The first sub-group consisted of 20 animals which were premunized with Babesia bigemina and Babesia argentina and 8 days later were treated with a new experimental babesiacidal drug. The second sub-group which consisted of 20 animals was simultaneously premunized with Babesia spp. and Anaplasma marginale and later treated with their respective specific drugs. The fourth group consisted of 20 female, 75 kg, Holstein, 3-month-old calves prophylactically treated with drug No. 4A65 and 3 weeks later exposed to Boophilus microplus naturally infected with Babesia bigemina and Babesia argentina. The fifth group consisted of 10 animals used as controls. Responses to vaccination and tick-borne challenge were evaluated by packed cell volumes, percentage of parasitemia, body temperatures, body weight, complement fixing antibody titers, general physical conditions, and percent recoveries after tick-borne challenge. Results in general indicate that resistance to babesiosis can be produced by co-infectious or sterile immunity. Experiments in prophylaxis, based on residual action of the babesiacidal drug, have given consistent and satisfactory results. In the future, it may be possible to develop control programs against bovine babesiosis based on these observations. The present status of these studies was described.

ADAMS, L. G. and FERREIRA, W. L.: Necrobacilosis Neo-Natal en Ovinos. Revista ICA, (September 1971), 6, (3).

Five cases of ovine neo-natal necrobacilosis, in the Sabana of Bogota, were diagnosed in lambs less than 2 weeks of age. Macroscopic and microscopic lesions were described and the diagnosis was confirmed by bacteriological cultural techniques. This report constitutes the first known notice of the disease in neo-natal lambs in Colombia.

BISHOP, J. P.: Immune Response of Cattle Inoculated With Irradiated Babesia bigemina. A Dissertation submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Doctor of Philosophy, December 1971.

Babesia bigemina parasitized blood exposed to varied doses of gamma radiation up to 60 kRad was inoculated into calves. Calves infected with 1×10^{10} B. bigemina parasitized erythrocytes exposed to doses up to and including 30 kRad developed progressive parasitemias. Some calves receiving 1×10^{10} parasitized erythrocytes irradiated at levels of 36 and 42 kRad did not develop progressive infections. Progressive infections were prevented by exposure to irradiation at 48 kRad or higher. Subinoculations into susceptible splenectomized calves from parasites thus treated failed to produce active infections.

A degree of acquired resistance to infection with B. bigemina developed in calves after 1 inoculation with B. bigemina parasitized blood irradiated at 48 and 60 kRad. The resistance was sufficient to suppress multiplication of the Babesia and to permit calves to survive otherwise severe clinical infections with nonirradiated parasites. There was also less erythrocytic destruction and a smaller increase in rectal temperatures following challenge. Presumably, the irradiated parasites were responsible for the development of resistance since irradiated nonparasitized blood did not produce a discernable acquired resistance.

The acquired resistance to infection with B. bigemina developed in calves inoculated with 1×10^{10} B. bigemina irradiated at 48 and 60 kRad was similar to the acquired resistance developed in calves inoculated with 1×10^{10} nonirradiated B. bigemina. It seems likely that the protective immunity produced with irradiated B. bigemina may be similar to that produced with living pathogenic B. bigemina in non-fatal infections. The acquired resistance to infection with B. bigemina developed in calves inoculated with 1×10^{10} B. bigemina irradiated at 48 and 60 kRad was much greater than the acquired resistance to infection developed in calves inoculated with 1×10^{10} heat killed B. bigemina. Thus, it seems likely that immunization with irradiated Babesia may provide the special immunological properties of living parasites important for producing a strong immunity while suppressing the pathogenic effects of the parasite. The Babesia parasites could be irradiated and frozen without apparent loss of immunizing properties.

DALEY, C. A.: A Sequential Study of the Pathogenesis of Disease Caused by Trypanosoma vivax in Experimentally Infected Calves, Utilizing Clinical, Pathological, Histopathological and Immunofluorescent Techniques. A Thesis submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Master of Science, May 1971.

Trypanosoma vivax obtained from a clinically sick cow near Neiva, Colombia, was passed in a sheep and a calf and inoculated into the jugular vein of 14 Holstein-Friesian calves. Fever occurred by 24 hours, and recurring parasitemia commenced after 72 hours. Associated with the first and subsequent parasitemias were decreases in hemoglobin, PCV, M:E ratio, serum albumin, A:G ratio and neutropenia.

All calves exhibited gradual weight loss by 2 weeks and later submandibular edema usually became evident. Consistent post mortem lesions seen after 4 weeks were conspicuously hypertrophied, edematous lymph nodes, hypertrophied hemal lymph nodes, emaciation, rounded right heart, palpably firm liver, atrophied thymus and hypertrophied femoral bone marrow.

Associated with T. vivax of the infecting inoculum and succeeding parasitemias were generalized endothelial hypertrophy and mononuclear cell infiltration along blood and lymph vessels with proteinuria and bone marrow hyperplasia. At 3 weeks there were aggregations of macrophages containing engulfed material distributed along capillaries in pulmonary interalveolar tissue, and this lesion in combination with the anemia and apparent cardiac insufficiency were thought important in the development of anoxia, and probably contributed to the single fatality observed.

GONZALEZ, E. F., TODOROVIC, R. A. and ADAMS, L. G.: Ultraestructura de la Babesia bigemina. Revista ICA, (March 1971), 6, (1): 89-112.

The morphology and some aspects related to the reproductive and feeding mechanism of Babesia bigemina have been studied by means of electron microscopy.

Although there are reports in the literature of the fine structure of Babesia canis which affects dogs, Babesia caballi which affects horses, and Babesia rodhaini which affects rodents, there is no report on the ultrastructure of B. bigemina which infects cattle.

B. bigemina was isolated from naturally infected cattle in the Valle del Cauca, Colombia, and maintained in splenectomized calves in the Laboratorio de Investigaciones Medicas Veterinarias in Bogota. Blood samples were collected from the splenectomized animals at a time when the percentage of parasitized erythrocytes was 25%, and these samples were used for electron microscopic studies.

By means of the electron microscope, different stages of B. bigemina were revealed such as oval, conoid and most commonly, pear shaped. The sizes of these forms were 2.5 to 6.5 microns in length by 2.3 microns in width. The young forms of the parasite were 1.5 by 2.5 microns. All these forms of parasites are surrounded by a dense cytoplasmic membrane which contained endoplasmic reticulum in the form of vesicles; these vesicles are composed of granules of different density. The endoplasmic reticulum appears as a homogenous mass with transparent vacuolar structures which are oval and spherical in shape. In addition to the endoplasmic reticulum, well defined dense polar bodies were found which appeared as oval shaped organelles, which communicated with the conoid part of the parasite by canals. The nucleus is the largest internal structure of the parasite and occupies one-fourth to one-third of its body. The nucleus is surrounded by a single membrane. Nucleoli were not revealed by electron microscopy.

Reproduction of B. bigemina appears to be carried out in two ways - by budding and binary fission. On the basis of these observations it is not clear which means of reproduction is more predominant. It is possible that both forms take place at the same time.

The feeding mechanism is not apparent. It appears that polar bodies play some role in this mechanism. These polar bodies could assume the function of food reservoirs of the parasite. It was also revealed that food vacuoles are similar to those in malarial parasites. The formation of food vacuoles probably results from an end process of pinocytosis as was described for Plasmodium species. We believe that both processes are involved in the feeding mechanism of Babesia parasites. Results of this study confirm the previously reported observation that there is no formation of pigment granules in Babesia; this implies that digestion of the host hemoglobin is complete; in contrast, malarial parasites form hemozoin, a blood pigment, as an end product of metabolism.

KUTTLER, K. L.: Efficacy of Oxytetracycline and a Dithiosemicarbazone in the Treatment of Anaplasmosis. American Journal of Veterinary Research, (September 1971), 32: 1349-1352.

The combination of a dithiosemicarbazone (356C61) and oxytetracycline proved more efficacious in the treatment of anaplasmosis than did either drug administered alone. The Anaplasma marginale carrier state in splenectomized calves was suppressed for as long as 120 days and was possibly eliminated by 3 injections of 356C61 (5 mg/kg) and oxytetracycline (11 mg/kg) given simultaneously at 48-hour intervals.

KUTTLER, K. L.: Promising Therapeutic Agents for the Elimination of Anaplasma marginale in the Carrier Animal. Proceedings of the 75th Annual Meeting of the USAHA, October 27, 1971, Oklahoma City, Oklahoma, 92-98 (published 1972).

Two new drugs, a dithiosemicarbazone (356C61) and 3,3'-bis(2-imidazolin-2-yl)-carbanilide dihydrochloride (4A65) have been successfully used to treat splenectomized calves with anaplasmosis. Carrier infections were eliminated with 5 or 10 mg/kg 356C61 and 11 mg/kg oxytetracycline when given 3 times at either a 24- or 48-hour interval. In addition, 5 mg/kg 356C61 plus 2 mg/kg 4A65 given 3 times at 24-hour intervals was effective in eliminating A. marginale infections. Levels of 4 and 6 mg/kg of 4A65 given 3 times at 24-hour intervals has proven successful in eliminating A. marginale infection.

KUTTLER, K. L., GRAHAM, O. H. and JOHNSON, S. R.: Apparent Failure of Boophilus annulatus to Transmit Anaplasmosis to White-Tailed Deer (Odocoileus virginianus). Journal of Parasitology, (June 1971), 57: 657-659.

Transovarial transmission of anaplasmosis occurred when two splenectomized calves were infested with unfed larvae of Boophilus annulatus, but no evidence of infection was detected in 2 intact white-tailed deer after they were infested with other larvae of common origin. All attempts to isolate Anaplasma marginale from the 2 deer by transfer of blood into splenectomized calves were unsuccessful.

MULLENAUX, C. H. and ADAMS, L. G.: La Oncocercosis Equina Asociada con el Mal de la Cruz en Colombia: Descripcion de dos casos. Revista ICA, (September 1971), 6, (3).

Two cases of equine fistulous withers were diagnosed in which Onchocerca spp. was found to be present in the affected tissues. One of the horses had a brucellosis antibody titer of 1:50 using the rapid plate agglutination method and, in the same animal, Brucella spp. was cultured from the suppurative materials of the nuchal bursitis of the withers. Macroscopic and microscopic pathological lesions caused by the nematode Onchocerca spp. were described.

TODOROVIC, R. A. and ADAMS, L. G.: Serologic Diagnosis of Babesiosis. Proceedings of the XIX World Veterinary Congress, August 15-22, 1971, Mexico City, 1114-1116.

The detection of the carrier state of bovine babesiosis has presented a particularly difficult problem because the blood from a high percentage of carrier animals does not contain sufficient Babesia parasites on which to base the diagnosis. Therefore, a great deal of past interest was concerned with the development of serologic techniques which would aid in diagnosing babesiosis.

In this review an attempt has been made to summarize and discuss the recent advances on sero-diagnosis of babesiosis in infected cattle with special attention to the serologic procedures used in the Laboratorio de Investigaciones Medicas Veterinarias located in Bogota, Colombia. In the last two decades fundamental knowledge concerning the immuno-serology of several Babesia spp. has led to the development of sero-diagnostic procedures for detection of Babesia antibodies. The antigens used in these techniques originated from parasitized erythrocytes and serum or plasma of animals with acute babesiosis, and they were applied in several serologic tests. The complement-fixation reaction constituted one of the earliest tests for the diagnosis of babesiosis. In recent years considerable progress was made to improve the complement-fixation test for the diagnosis of babesiosis. In addition, gel precipitation, fluorescent antibody, and agglutination techniques were applied for the detection of specific Babesia antibodies utilizing antigens from the parasitized erythrocytes as well as acute serum.

The investigations described in this report were conducted to develop the new techniques and to evaluate existing techniques for diagnosing bovine babesiosis. Research was executed in collaboration with the Instituto Colombiano Agropecuario in the Laboratorio de Investigaciones Medicas Veterinarias in Bogota, Colombia. Antigens of Babesia spp were isolated by means of two techniques and used in the complement-fixation test for the detection of Babesia antibodies in cattle experimentally and naturally infected. By means of the complement-fixation test it was possible to detect specific antibodies in the serum of cattle 8 days after blood-borne infection. A total of 5,420 serum samples of cattle infected with babesiosis were tested. The cattle were from several Colombian experimental herds with known histories of babesiosis located in Valle del Cauca, Rio Magdalena, Llanos and Monteria and from cattle artificially infected in the Laboratorio de Investigaciones Medicas Veterinarias in Bogota. Approximately 95% of these samples were positive; whereas, about 5% gave discordant reactions. In addition to the complement-fixation test used in our laboratory, attempts were made to apply the double-gel diffusion for characterization of Babesia spp. antigen-antibody reactions. A cross reaction was noted between Babesia bigemina and Babesia argentina in this system. The application of latex-agglutination and hemo-agglutination tests for the detection of the Babesia antibodies are still under investigation in our laboratory. As a result of these investigations and observations, it is apparent that more investigation is needed for the development of a practical serologic technique for the diagnosis of babesiosis and to help solve this complex biological disease problem in tropical and sub-tropical areas of the world.

TODOROVIC, R. A., GONZALEZ, E., MATEUS, G. and ADAMS, L. G.: Simultaneous Control of Helminths, Anaplasmosis and Babesiosis in Cattle. Revista de la Facultad de Medicina Veterinaria y Zootecnia, Univ. Nac. de Colombia, Bogota, (1971), 33: 47-58.

A group of 50 male, Holstein-Friesian calves, 3 to 4 months old, were used to evaluate a control program for gastrointestinal and hemotropic parasites. The experiment was conducted at the ICA experimental station in Palmira, Valle del Cauca, at an elevation of 1,000 meters. The animals were divided into 3 groups.

Twenty animals were premunized against anaplasmosis and babesiosis simultaneously; 8 days later they were treated against babesiosis using the compound 4A65 at a dosage of 1 mg/kg of body weight, and 21 and 56 days after premunition they were treated intravenously with the compound 356C61 (5 mg/kg IV) against anaplasmosis.

Twenty animals were premunized against anaplasmosis as it was done with the animals in Group I. Animals in this group were vaccinated with AGS plus adjuvant vaccine against babesiosis. The vaccine was repeated 14 days later. Animals in Groups I and II were treated twice during the experiment with Ripercol (Tetramisol) against gastrointestinal parasites.

Ten animals were not treated and were used as controls.

All three groups of calves were kept under the same environmental conditions and the same management. The experiment was carried out during a period of 8 months. Blood samples were collected to evaluate anemia and parasitemia. The antibody titer was determined by the complement-fixation test. The body weights were measured and the fecal samples were examined for the presence of gastrointestinal parasites. Animals in Groups I and II had a high degree of resistance to babesiosis and anaplasmosis infections as a result of effective premunition and vaccination techniques. However, the animals in the control group had clinical babesiosis and anaplasmosis and high infestation with gastrointestinal parasites.

The importance of simultaneous control of gastrointestinal and hemotropic parasites is pointed out and methods to control these parasites are given.

TODOROVIC, R. A., LUQUE, G. F. and ADAMS, L. G.: Contribution to the Study of the Tick Distribution in Colombia, South America. Revista de la Facultad de Medicina Veterinaria y Zootecnia (accepted for publication).

The purpose of this work was to collect and identify tick species involved in the epizootiology of bovine babesiosis in Colombia. Bovine babesiosis was reported in Colombia in 1888 but there is not any published evidence about tick species involved in the transmission of the disease. Although Boophilus microplus is the predominant tick in medium and hot climates, the exact distribution of the tick in the different regions of Colombia is not known. To develop an effective control program, the distribution of tick species needs to be determined. This is the first attempt to obtain this information about tick distribution in Colombia.

Animals naturally infected with Babesia bigemina and Babesia argentina were used as a tick collection source. The infectivity of these animals was determined by blood smears and complement-fixation techniques. The animals were located on farms in Palmira (Valle del Cauca) and Turipana (north coast), Magdalena River and Sumapaz River. Ticks were collected from different breeds: Holstein-Freisian, Zebu, Blanco Orejinegro, and Costeno con Cuernos, in animals of different ages. The ticks were collected from different parts of the animal bodies and preserved in Ethanol 95%. Adults, nymphs, and larvae were collected from both sexes for identification purposes during a 12-month period (January - December).

Dermacentor nitens was found in the animals infected with babesiosis in the Valle del Cauca, north coast, Sumapaz River; Amblyomma cayennense was found in animals infected with babesiosis and anaplasmosis in the Magdalena River and the north coast; Boophilus microplus was found in the same animals infected with babesiosis and anaplasmosis used in this experiment. Until the present time the significance of the findings of Amblyomma and Dermacentor ticks in epidemiology of babesiosis is not clear.

Experiments are in progress to determine the population and distribution of the tick species in other parts of Colombia for the purpose of investigating the exact role of Dermacentor nitens and Amblyomma cayennense in the transmission of bovine babesiosis.

ZARAZA, H. and KUTTLER, K. L.: Comparative Efficacy of Different Immunization Systems Against Anaplasmosis. Tropical Animal Health & Production, (1971), 3: 77-82.

Animal response to anaplasmosis vaccination was measured using an attenuated organism, a killed adjuvant vaccine, and a virulent Anaplasma marginale. A total of 7 calves (2-4 months of age) and 5 heifers (18 months of age) received the attenuated organism; 8 calves were given the adjuvant vaccine; 7 calves were premunized with virulent A. marginale; and 7 calves remained as non-vaccinated controls. The animals were vaccinated at Tibaitata on the Bogota Savannah and later moved to the north coast of Colombia, an anaplasmosis enzootic area.

All vaccination methods produced positive CF results. The live agents resulted in low parasitemias in most instances, although the attenuated organism was particularly mild in the younger animals.

Protection from field challenge was observed in all calves premunized with virulent organism, and in 2 of 5 heifers premunized with the attenuated organism. All other vaccinated animals developed anaplasmosis which was equally as severe as seen in the non-vaccinated controls.

ADAMS, L. G.: Epizootia Espontanea de Hepatitis Toxica en Porcinos Atribuida a Aflatoxicosis. Revista ICA (accepted for publication).

Nine of the 56, 4- to 6-month-old Duroc male and female pigs died 2 months after consuming a ration consisting of 8.75% moldy peanut meal The pigs exhibited weight loss, roughened hair coats, anorexia, lethargy, icterus, melena, increased followed by decreased rectal temperature and death. The livers of the remaining 45 pigs were condemned due to cirrhosis. Serum sorbitol dehydrogenase activities, glutamic-oxaloacetic transmission activities, bilirubin concentrations, serum beta globulin levels, serum gamma globulin levels, and total serum protein concentrations were increased as serum albumin/globulin rations, albumin levels, packed cell volume and hemoglobin contents were decreased. No changes were observed in total leukocyte counts or serum alpha globulin levels.

The principal macroscopic lesions consisted of generalized icterus, petechial and ecchymotic hemorrhages with yellow transudates occurring in the body activities. Subendocardial as well as subserosal ecchymotic hemorrhage were commonly observed. Ulceration of the gastric fundus occurred which filled the stomach, duodenum, jejunum, ileum, and colon with free digested and undigested blood. The liver was pale yellowish-brown, firm (increased cutting resistance), and cirrhotic with very accentuated hepatic lobules outlined by translucent bands. Hundreds of irregular round yellow to brown foci of hepatic nodular regeneration were interspersed throughout the hepatic parenchyma. The gall bladder was moderately edematous and contained a small amount of light green bile. The principal microscopic lesions of the liver were disorganization of the hepatic architecture, acinus formation, severe sinusoidal fibrosis, mild biliary hyperplasia, advanced hepatic nodular regeneration, extensive hepatocellular megalocytosis, hepatocellular anisocytosis, mild hepatocellular necrosis, fatty metamorphosis, and moderate cholangiolar bile plug formation. The diagnosis and etiology of these 4 cases of porcine chronic toxic hepatitis was attributed to aflatoxicosis apparently produced by Aspergillus flavus growing on peanut meal. The present article is the first report of aflatoxicosis in Colombia.

ADAMS, L. G., CRAIG, T. M., PLATT, K. B. and WYSS, J. H.: Bovine Eperythrozoonosis in Colombia. Revista ICA (accepted for publication).

Eperythrozoon wenyoni, E. teganodes and E. tuomii were diagnosed in 14 of 37 splenectomized, Holstein-Friesian, 4- to 11-month-old calves that originated from the Sabana de Bogota. Eleven calves had pure infections of E. wenyoni, 2 calves had dual infections of E. wenyoni and E. teganodes, and 1 calf had a pure infection of E. tuomii. The diagnosis was determined on Giemsa-stained blood smears, and morphological descriptions of the Eperythrozoon spp. were given. Six splenectomized calves exhibited depression and anorexia, but all 14 calves had elevated rectal temperatures. Two calves had serous conjunctivitis with excessive lacrimation. The increase in rectal temperature coincided with the onset of parasitemia while the packed cell volume decreased after the onset of parasitemia. The average incubation period and standard deviation was 14.9 ±3.5 days post-splenectomy. Treatment with 2-di-(Beta, gamma-dioxipropil)-(aminofenol)-(4 arseno 5)-Beta-(benzaxozalil)-(2)-mercaptol-proprionato de sodio at 29 mg/kg intramuscularly caused the parasitemia to become undemonstrable within 24 hours with further recrudescence occurring within 6 weeks. This is the first report of bovine eperythrozoonosis due to Eperythrozoon wenyoni, E. teganodes and E. tuomii in Colombia.

CORRIER, D. E.: A Clinical, Serologic and Pathological Study of Concurrent Anaplasmosis and Babesiosis in Experimentally Infected Calves. A Thesis submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Master of Science, December 1972.

Concurrent and single infections of Anaplasma marginale and Babesia bigemina were studied in 22, 7 month old, male, non-splenectomized Holstein-Friesian calves. Clinical manifestations of disease were mild, consisting primarily of slight fever, poor body condition, and reduced weight gains. Anaplasma marginale appeared to be the more pathogenic of the 2 organisms.

Associated with the appearance of parasitized erythrocytes were decreases in packed cell volume, hemoglobin, albumin:globulin ratio, and serum albumin, and slight increases in the levels of serum bilirubin, serum glutamic oxalacetic transaminase, and alpha and beta serum globulins. Decreases in PCV and hemoglobin concentration were more prolonged and severe in the concurrently infected calves. Complement fixing antibodies for Anaplasma occurred on days 17 to 26 in association with increases in alpha and beta globulins. Complement fixing antibodies for Babesia were first observed on day 12 post inoculation.

Gross lesions observed in the concurrently infected calves included a moderately excessive quantity of yellow fluid in the peritoneal and pleural cavities, moderate lymph node enlargement, splenomegaly and hepatomegaly, moderate renal congestion, and occasional serous atrophy of depot fat.

Hepatocellular degeneration and necrosis were observed in the centrolobular areas of the liver. Lymphoid hyperplasia was observed in the malpighian corpuscles of the spleen and in the lymphoid follicles of the lymph nodes. Hemosiderosis of the spleen, liver, kidney and lymph nodes was attributed to the increased removal of damaged erythrocytes from the circulation with the subsequent release of breakdown products of hemoglobin.

The biological relationship of A. marginale and B. bigemina during the concurrent infection appeared to be one of independency. Neither an inhibitory nor a synergistic relationship was apparent during the investigation. The clinical and pathological manifestations of concurrent infection were more severe than those observed during infection with either of the hemotropic parasites alone, and were attributed to the concurrent infection being additive in nature.

HERNANDEZ, J. D., ROBERTS, E. D., ADAMS, L. G. and VERA, T.: Pathogenesis of Hepatic Granulomas in Turkeys Infected with Streptococcus faecalis var. liquefaciens. Avian Diseases, (January - March 1972), 16, (2): 201-216.

The pathogenesis of hepatic granulomas in turkeys has been studied by reproducing the lesions experimentally with Streptococcus faecalis var. liquefaciens isolated during a field outbreak of turkey hepatic granulomas in Colombia. The 170 turkey poults (Bronze) used were 4 weeks old. Groups of poults were inoculated intravenously or orally with 0.1 ml of a 24-hour culture of Streptococcus faecalis var. liquefaciens at a dilution of 3 x 10 on the MacFarland Nephelometer Standard 10. The oral route of inoculation reproduced a disease most similar to the naturally occurring disease.

Clinically, the acute phase of infection was characterized by a high mortality rate in the first to seventh days but only sporadically thereafter. The septicemic phase produced the formation of septic thrombi which localized in various organs, producing infarction with heterophilic infiltration. Once the septicemic phase of the problem passed, the disease was manifested primarily by a focal hepatitis initiated primarily as a focal necrotic cholangial lesion. The biliary epithelium had hyperplastic to degenerative processes which participated in the formation of biliary thrombi. Granulomas were characterized by focal areas of necrosis surrounded by Langhans-type giant cells and macrophages.

JONES, F. M.: Control of Anaplasmosis and Babesiosis in Young Cattle. A Thesis submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Master of Science, December 1972.

A study was conducted on the control of anaplasmosis and babesiosis in young cattle in Colombia. Three groups of 10 calves were used at each of 3 different climatic and geographic areas. One group was vaccinated with an attenuated Anaplasma marginale vaccine and a killed Babesia bigemina, Babesia argentina vaccine. A second group was injected with infected A. marginale, B. bigemina and B. argentina blood that originated from donor cattle from the eastern plains. Five days post inoculation the induced infection was treated by injection of compounds 356C61 (alpha-ethoxyethyl-glyoxal dithiosemicarbazone) and 4A65 (3,3-Bis-(2-imidazolin-2-yl) carbanilide dihydrochloride). The third group of calves was used as a control. Calves selected for use at Monteria were not native to that area. All calves were subjected to natural exposure. Ticks were collected and identified at each site.

There was no apparent significant difference in weight gains and resistence to anaplasmosis and babesiosis between groups at any site. At Bugalagrande and Girardot the absence of death losses from anaplasmosis and babesiosis in the control groups indicates that the calves had a pre-existing natural immunity, an acquired non-sterile immunity at the beginning of the study, or no challenge during the study. At Monteria, it is apparent that the vaccinated and premunized calves did not develop resistance to anaplasmosis and babesiosis due to the use of antigenically different organisms; the simultaneous injection of the premunization drugs at 5 days post inoculation; the lack of sufficient sterile immunity to suppress tick-borne infection; or the inability of the very young calves to develop sufficient resistance.

The identification of Boophilus microplus ticks at all 3 sites confirms reports of this vector in anaplasmosis and babesiosis enzootic areas of Colombia. The significance of Anocentor nitens ticks on Anaplasma and Babesia spp. infected cattle is not apparent at this time.

As a result of this study, it is concluded that the control of bovine anaplasmosis and babesiosis in tropical areas is more complex than previously recognized. More investigation is needed to obtain information on strain antigenicity of Anaplasma marginale, Babesia bigemina and Babesia argentina; mechanisms of coinfectious immunity; sterile immunity; and the action of chemical compounds tested in this study.

KUTTLER, K. L.: Combined Treatment With a Dithiosemicarbazone and Oxytetracycline to Eliminate Anaplasma marginale Infections in Splenectomized Calves. Research in Veterinary Science, (November 1972), 13, (6): 536-539.

A total of 12 treatment schedules combining oxytetracycline and an alpha-dithiosemicarbazone (356C61) were tested on 36 splenectomized calves carrying Anaplasma marginale infections. Anaplasma infection was eliminated following the administration of 5 or 10 mg/kg 356C61 combined with 11 mg/kg oxytetracycline, and given 3 times at 24 or 48 hour intervals. Treatments employing lower levels, fewer injections, or at greater time intervals failed to eliminate infection.

Treated, splenectomized calves failing to show evidence of an A. marginale relapsing infection within 62 days were found to be free of infection on the basis of infectivity trials conducted an average of 87 days after treatment, and by re-inoculation with A. marginale an average of 164 days after treatment.

KUTTLER, K. L.: Comparative Response to Premunization Using Attenuated Anaplasma marginale, Virulent A. marginale and A. centrale in Different Age Groups. Tropical Animal Health & Production, (1972), 4: 197-203.

Premunizing infections using virulent Anaplasma marginale (VAM), attenuated A. marginale (AAM) and A. centrale (AC) have been induced in 46 mature cattle, 33 intact calves, and 38 splenectomized calves, for the purpose of comparing the relative response to these infections.

The VAM produced significantly more severe reactions in adult cattle and splenectomized calves, and a slightly more severe response in intact calves; however, these animals were relatively more resistant to all three infections. There was no detectable difference between the reactions caused by AAM and AC when measured in adult cattle and intact calves. Among splenectomized calves, however, the AAM infections resulted in a milder response as measured by the relative drop in packed cell volume and percent parasitemia. The CF response was significantly lower in the AC infection.

KUTTLER, K. L., GRAHAM, O. H., JOHNSON, S. R. and TREVINO, J. L.: Unsuccessful Attempts to Establish Cattle Babesia Infections in White-Tailed Deer (Odocoileus virginianus). Journal of Wildlife Diseases, (January 1972), 8: 63-66.

Attempts to induce a demonstrable cattle Babesia infection by feeding known infected ticks on two white-tailed (Odocoileus virginianus) deer were unsuccessful. The injection of known Babesia carrier blood into an intact and a splenectomized deer failed to result in evidence of infection.

All deer were checked for possible sub-patent infections by inoculating their blood into splenectomized calves at weekly intervals for 5 weeks following exposure, but no infections were produced in the calves.

Babesia infected ticks having undergone one generation on deer were unable to transmit infection to splenectomized calves on the succeeding generation.

ARMSTRONG, J. M. and TODOROVIC, R. A.: Anaplasmosis of Cattle. Texas Agricultural Extension Service, A Fact Sheet, No. 10 M-6-73, (1973), 1-4, (abstract).

A brief description of anaplasmosis, with special emphasis on recent achievements in the field of diagnosis and control was discussed and summarized for Texas A&M University Extension Service publication. This fact sheet was written principally for livestockmen to make them aware of recent developments in the field of anaplasmosis control and action that can be taken for prevention and treatment of this hemotropic disease.

BISHOP, J. P. and ADAMS, L. G.: Combination Thin and Thick Blood Films for the Detection of Babesia Parasitemia. American Journal of Veterinary Research, (September 1973), 34, (9): 1213-1214.

A method for preparing and examining combination thin and thick blood films for the detection of Babesia spp. parasitemias was developed. A technique for staining the combination thin and thick films, using a phosphate-buffered Giemsa stain solution containing alkyl phenoxy poly-ethoxy ethanol (APPE), was also described.

BISHOP, J. P., ADAMS, L. G., THOMPSON, K. C. and CORRIER, D. E.: The Isolation, Separation and Preservation of Babesia bigemina. Tropical Animal Health & Production, (May 1973), 5: 141-145.

Experiments were performed in Colombia to separate Babesia bigemina from contaminating organisms. Babesia bigemina was passaged serially through five splenectomized calves. The first calf was inoculated with blood carrying several different organisms, and subsequent subinoculations were done soon after blood smears from each calf were found to be positive for B. bigemina. Five blood passages were carried out in 6.5 days. Babesia argentina, B. major and A. marginale were eliminated as contaminants of the B. bigemina isolated after four passages. A frozen stabilate of the isolated B. bigemina was established.

CORRIER, D. E. and ADAMS, L. G.: Observations During Concurrent Anaplasmosis and Babesiosis in Experimentally Infected Calves. Proceedings of the 6th National Anaplasmosis Conference, March 1973, Las Vegas, Nevada, 60-65.

The clinical, serological and pathological manifestations of disease in intact calves concurrently infected with Anaplasma marginale and Babesia bigemina were investigated. Clinical signs were more severe in the concurrently infected calves than in singularly infected controls. Decreases in packed cell volume, albumin:globulin ratio, myeloid:erythroid ratio and increases in the number of reticulocytes, total serum proteins and serum gamma globulins were more pronounced in the concurrently infected calves. The concurrent infections had no apparent effect on the production of complement fixing antibodies. Gross lesions observed in the concurrently infected calves included: pleural and peritoneal transudates; splenomegaly; hepatomegaly; and moderate lymph node enlargement. Histological lesions included: moderate hepatocellular degeneration; lymphoid hyperplasia in the spleen and lymph nodes; and hemosiderosis of the spleen, lymph nodes, liver and kidneys. The relationship of A. marginale and B. bigemina during the concurrent infections appeared to be one of independency. The increased severity of the clinical and pathological signs of disease in the concurrently infected calves was attributed to the concurrent infections being additive.

CRAIG, T. M.: Infectivity and Cross Immunity Studies of Colombian Bovine *Babesia* Species. A Thesis submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Master of Science, December 1973.

Colonies of bovine hemotropic disease free *Boophilus microplus* ticks were established. Adult *B. microplus* females and eggs were incubated at 28 to 30° C. at a relative humidity of from 70 to 80%. Larvae were maintained at 24 to 28° C. and a relative humidity of 60 to 80% for maximal survival.

A colony of *B. microplus* infected with *Babesia argentina* was established by allowing non-infected ticks to feed on normal cattle for 10 to 11 days, at which time a stabilate of *B. argentina* was inoculated into the cattle subcutaneously. This resulted in a parasitemia at the time of final tick engorgement. The organism was maintained in ticks by allowing non-infected ticks to feed on a calf which was later infected by the release of infected larvae 11 to 13 days after the non-infected larvae commenced feeding. Diagnosis of *Babesia spp.* in ticks was done by examination of hemolymph.

Diagnosis and estimation of the effects of *Babesia spp.* infections in cattle were made on the basis of thick and thin blood films, packed cell volumes, rectal temperatures, body weights, cerebral biopsies, complement fixation titers and clinical signs.

Boophilus microplus eggs, larvae and nymphs infected with *B. argentina* were disrupted by several methods and the resulting material inoculated subcutaneously into splenectomized calves. None of the calves showed signs of infection and proved to be fully susceptible when challenged with *B. argentina*.

Babesia bigemina was isolated from other bovine hemotropic agents by rapid serial passage through splenectomized calves. This isolate was compared with a laboratory strain previously isolated from a different geographic region of Colombia. Two groups of 8 calves each were inoculated subcutaneously with 10^9 *B. bigemina* organisms of each isolate. A third group of 8 calves remained as untreated controls. Twenty-eight days later, 4 calves in each of the 3 groups were challenged with $2x10^{10}$ *B. bigemina* organisms of each isolate. The challenge groups were homologous, heterologous and control. Both homologous and heterologous groups demonstrated immunity to challenge. No differences in the virulence of the two isolates were demonstrated.

KUTTLER, K. L.: Current Status of the Tropical Cattle Fever Tick Boophilus microplus and Texas Wildlife. Presented to the Wildlife Society, Texas Chapter, Annual Meeting - April 5, 1973, Barnet, Texas, (abstract).

The increasing presence of both Boophilus annulatus and Boophilus microplus have created considerable concern among both the Texas livestock industry and those interested in the preservation and maintenance of wildlife. Even though both ticks can complete their life cycles on deer, B. microplus appears better adapted to deer. This tick is very versatile and is capable of maintaining itself on several wildlife species. Neither B. annulatus nor B. microplus are capable of transmitting any known diseases from deer to cattle or from cattle to deer.

Eradication plans have been successful in the past, particularly where B. annulatus was present. The feasibility of B. microplus eradication by similar means was discussed.

KUTTLER, K. L.: East Coast Fever (Theileriasis, Theileriosis, Rhodesian Tick Fever, Rhodesian Red Water). Submitted for publication in the 1973 revision of the "Foreign Animal Diseases" manual, U. S. Animal Health Association, Committee on Foreign Animal Diseases

A review of the literature with a comprehensive discussion of East Coast Fever is given. This hemoprotozoal agent (Theileria parva) is considered by many to be the single most serious tick-borne disease occurring in East Africa. The 3 host tick, Rhipicephalus appendiculatus, is difficult to control and most ranches where it occurs will dip their cattle every week. The disease organism is readily transmitted by this and other tick vectors and produces a disease which may produce mortality of over 90%. This disease is limited to the African continent; however, similar infections caused by T. annulata and T. mutans have a much broader distribution. Theileria mutans is generally considered non-pathogenic, but T. annulata is a major disease producing hemoparasite, but generally of less virulence than T. parva.

KUTTLER, K. L.: Review: Current Status of Control and Treatment With Drugs. Proceedings of the 6th National Anaplasmosis Conference, March 1973, Las Vegas, Nevada, [illegible] (abstract).

A review of the literature was given, emphasizing those treatment techniques and reports since the initial use of the tetracyclines for anaplasmosis in 1951. Two new drugs, Imidocarb and Gloxazone, were discussed. These drugs, while more effective than the tetracyclines, have not been cleared by the FDA and remain experimental. At the present time, the tetracyclines are the only effective therapeutic compounds available commercially for the treatment of anaplasmosis. Current recommendations for the elimination of carrier infections are to feed an oral tetracycline for 60 days at the rate of 5 mg/pound of body weight.

KUTTLER, K. L. and TODOROVIC, R. A.: Arthropod Borne Protozoan Infections (Affecting Domesticated, Food-Producing Animals). Submitted for publication in the 1973 revision of the "Foreign Animal Diseases" manual, U. S. Animal Health Association, Committee on Foreign Animal Diseases.

A review of the literature with a comprehensive discussion of anaplasmosis and babesiosis is given. In addition, tables of different Babesia spp., Theileria spp., Trypanosoma spp., Anaplasma spp., and Leucocytozoon spp. are given with reference to animals affected, morphology of the organism, and potential vectors. Brief descriptions of besnoitiosis and leucocytozoonosis are also given.

Despite progress in developing more effective acaracides and more efficient therapeutic agents, the arthropod borne hemoparasites remain a major disease problem in the tropics and the subject of intense research.

KUTTLER, K. L. and TODOROVIC, R. A.: Techniques of Premunization for the Control of Anaplasmosis. Proceedings of the 6th National Anaplasmosis Conference, March 1973, Las Vegas, Nevada, 106-112, (abstract).

Attempts at Anaplasma premunization in varying age groups have been reported using a virulent A. marginale of Texas origin, a virulent A. marginale of Colombian origin, an attenuated A. marginale, and A. centrale. Results of premunization response and the response to field and artificial challenge have been reported.

Premunization is a practical approach for the prevention of clinical losses associated with anaplasmosis, but a series of variables must be considered if success is to be achieved. Some of these factors are: (1) age of the animals being premunized, (2) virulence, potency, and size of the premunizing inoculum, and (3) the strain, or size, of the expected challenge exposure. In some instances, the use of a highly virulent A. marginale in adult cattle resulted in overly severe reactions even with treatment. Gloxazone (356C61) and Imidocarb (4A65) were superior to oxytetracycline in moderating the premunizing infection. Attenuated strains of A. marginale when used in young intact calves failed to produce the desired premunizing effect; however, attenuated strains were very effective in adult cattle. Premunization is dependent on establishing an active infection, and in the absence of such infection, susceptibility to field or experimental challenge occurs.

Successful premunization resulted in almost complete protection following challenge with antigenically similar A. marginale isolates. Protection was only partial, however, in instances where heterologous challenge was encountered.

MAURER, F. D.: The Need for Knowledge of Foreign Animal Diseases. Introductory chapter for the 1973 revision of the "Foreign Animal Diseases" manual, U. S. Animal Health Association, Committee on Foreign Animal Diseases.

As the introduction to a text on the diagnosis, prevention and control of diseases foreign to the United States, it is a chapter of justification for a national interest in exotic animal diseases. Justification is based upon the need to protect U. S. livestock industries, as animal diseases are major handicaps to efficient livestock production, hence, the food supply in the U.S.A. and abroad. Further, with the world's population rapidly exceeding its food supply and many people suffering from protein deficiencies, there is an urgent need to develop all sources of animal protein. Only ruminant animals are capable of converting range forages and many crop by-products into food for man.

While all animal diseases are a handicap to efficient production, the most highly fatal, infectious diseases which impose the greatest burdens are among those exotic to the United States. This results in a marked contrast in livestock productivity between developed and developing countries. With only 40% of the world's livestock in developed countries, they produce 80% of the world's meat, milk and eggs.

If we are to protect U. S. livestock against the threat of exotic disease and help developing nations feed themselves, we must have knowledge of the major diseases and know how to control them. Should we neglect opportunities to improve world food production, we increase the chances of regional starvation with the associated social, economic and political instability which lead to aggression.

MAURER, F. D.: Rinderpest. Submitted for publication in the 1973 revision of the "Foreign Animal Diseases" manual, U. S. Animal Health Association, Committee on Foreign Animal Diseases.

Rinderpest is an acute, febrile, virus disease which spreads by direct and indirect contact between ruminants, primarily cattle and buffalo. It is characterized pathologically by inflammation, hemorrhage, necrosis and erosion of the digestive tract accompanied by a wasting, frequently bloody diarrhea. Less acute forms may occur in resistant cattle. Since ancient times, Rinderpest has been the world's most devastating disease of cattle and, as such, has had a major influence on man's food supply. Prior to 1949, Rinderpest killed over 2 million cattle and buffalo per year. Losses continued until effective vaccines were developed and immunity maintained. It is only through such immunity that cattle raising is now profitable in Africa, the Middle East, and Asia. The presence of Rinderpest anywhere serves as a constant threat to the rest of the world. The U. S., like other free nations, must be alert to its recognition, and be prepared to accomplish prompt confirmatory diagnosis and control.

MAURER, F. D. and McCULLY, R. M.: African Horsesickness. Submitted for publication in the 1973 revision of the "Foreign Animal Diseases" manual, U. S. Animal Health Association, Committee on Foreign Animal Diseases.

The chapter describes the history, geographic distribution, etiology, clinical character, pathology, diagnosis, preventive immunity, epidemiology, and control of this most destructive disease of equine animals. African Horsesickness is a highly fatal, insect-borne, febrile, virus disease clinically dominated by an acute pulmonary edema or a hemorrhagic myocarditis associated with localized areas of inflammatory edema and hemorrhage. Long confined to south and equatorial Africa, in the 1960's it spread via the ubiquitous culicoides vectors throughout 11 countries of the middle east, North Africa, and Spain, killing many hundreds of thousands of equines. In view of the essentially worldwide distribution of culicoides vectors, African Horsesickness is a prevailing threat to the western hemisphere and elsewhere. With 9 known antigenically different strains of virus, polyvalent vaccines oriented to the strains involved are required to protect threatened equines. Each country, including the United States, needs to be prepared to promptly diagnose and, if need be, vaccinate against African Horsesickness.

MAURER, F. D. et al.: Livestock Production and Marketing in Pakistan. A 107 page report to AID based upon a month's survey in August 1973.

TODOROVIC, R. A.: Bovine Babesiosis: Its Diagnosis and Control. Proceedings of the 7th Panamerican Veterinary Congress, July 1973, Bogota, Colombia, 39-40, (abstract).

The investigation was conducted to develop new systems and to evaluate existing ones for the diagnosis and control of bovine babesiosis in Colombia, South America. Antigens of Babesia bigemina and Babesia argentina were isolated and used in the complement fixation and rapid agglutination tests for the diagnosis of babesiosis in cattle. Three systems were evaluated for the control of bovine babesiosis: (1) vaccination of susceptible cattle with killed Babesia spp. vaccine to produce resistance based on sterile immunity; (2) premunition of cattle with virulent Babesia spp., followed by chemotherapy to produce resistance based on co-infectious immunity; and (3) chemoprophylaxis based on the activity of babesiacidal compounds with prolonged residual action. All these systems were found effective in controlling bovine babesiosis under the conditions of these experiments. The epizootiological conditions of babesiosis enzootic areas will indicate which system is applicable. In zones with a high incidence of Boophilus microplus, the premunition is indicated; in areas where the tick population is controlled, or in areas at constant risk of tick exposure, the system of inducing resistance with killed Babesia spp. or chemoprophylaxis is indicated.

TODOROVIC, R. A., GONZALEZ, E. F. and ADAMS, L. G.: Bovine Babesiosis: Sterile Immunity to Babesia bigemina and Babesia argentina Infections. Tropical Animal Health and Production, (1973), 5: 234-245.

Killed Babesia bigemina and Babesia argentina vaccine was prepared from the infected erythrocytes (AG-E) and from the infected plasma (AG-S) collected from acutely infected calves with B. bigemina and B. argentina. The vaccine was tested in Colombian cattle under field conditions in the Cauca Valley. A total of 40 calves two and one-half months of age received killed-Babesia vaccine. Five calves were not vaccinated; they served as controls. Vaccinated and non-vaccinated control calves were exposed to field-borne challenge with Boophilus microplus infected ticks. On the basis of the data obtained in these experiments, it was found that a high degree of sterile immunity to B. bigemina and B. argentina can be produced in calves injected with killed-Babesia vaccine. It appears that sterile immunity plays an important role in the mechanism of acquired immunity to babesiosis other then well-known co-infectious immunity known as premunition.

TODOROVIC, R. A., VIZCAINO, O. G., GONZALEZ, E. F. and ADAMS, L. G.: Chemoprophylaxis (Imidocarb) Against Babesia bigemina and Babesia argentina Infections. American Journal of Veterinary Research, (September 1973), 34, (9): 1153-1161.

The chemoprophylactic effects of imidocarb (3,3'-bis-(2-imidazolin-2-yl)carbanilide dihydrochloride) against bovine babesiasis were evaluated in 29 calves. The compound had prophylactic and therapeutic properties in calves artificially or naturally infected with Babesia bigemina and Babesia argentina of Colombian (South American) origin. Administered intramuscularly at the dose level of 2 mg/kg, imidocarb suppressed the development of acute babesiasis in calves treated 46 days previously and later exposed to a lethal dose of Babesia spp.-infected blood. Imidocarb failed to protect against Anaplasma marginale infection. Calves treated intravenously with imidocarb at dose level 2 mg/kg and challenge inoculated 20 days later with a lethal dose of Babesia spp.-infected blood were protected. For 90 days after challenge, none of the calves had Babesia spp. parasitemia, as determined by examination of stained blood films and by subinoculation of blood into susceptible splenectomized calves. Calves intravenously treated 21 days previously with 3 mg of imidocarb per kilogram resisted tick-borne challenge of Boophilus microplus. This resistance was evidenced for 15 weeks of field exposure by negative results of examinations of stained blood films and death of nontreated calves from acute babesiasis. All calves treated with imidocarb and subsequently exposed to blood or tick-borne Babesia spp. responded with an increase of complement-fixing antibodies.

Imidocarb readily controlled severe acute infections with B. bigemina and B. argentina when the compound was given at dose rates of 1 mg/kg by both intramuscular or subcutaneous routes. Signs of acute toxicosis were observed in calves given intravenous injections of 3 mg/kg. Three calves died, having signs of embarrassed respiration, oral respiration, excessive salivation, muscular fasciculations, urination, defecation, incoordination, and prostration. Signs of toxicosis were milder with intramuscular or subcutaneous injections of imidocarb.

VIZCAINO, O. G. and TODOROVIC, R. A.: Produccion de Antigenos Solubles de Babesia argentina y Babesia bigemina para Pruebas de Immunodiffusion. (Soluble Antigens of Babesia bigemina and Babesia argentina and Their Application in Serologic Tests.) Proceedings of the 7th Panamerican Veterinary Congress, July 23-28, 1973, Bogota, Colombia, 38-39, (abstract).

Diagnosis of bovine babesiosis during the acute phase of infection is made by examination of Giemsa-stained blood films; however, during the chronic phase of disease, several serologic tests are used for detection of specific Babesia spp. antibodies. The purpose of the present investigation was to isolate soluble antigens of Babesia bigemina and Babesia argentina from blood acutely infected with these hemotropic parasites and use them in immunodiffusion tests for detection of specific antibodies.

Soluble antigens of B. bigemina and B. argentina were isolated from plasma collected from animals acutely infected with these parasites. By means of column chromatography (DEAE-cellulose and Sephadex-G2000), soluble antigens of B. bigemina and B. argentina were purified from host material and found antigenically specific in gel diffusion tests. Antigenic fractions obtained by above procedures were found to contain protein at 280 µw of optical density.

By means of DEAE-cellulose column chromatography, it was possible to separate host hemoglobin from soluble antigens of B. bigemina and B. argentina. Three protein peaks were recorded during fractionation, but only the second peak contained soluble antigens contaminated with host serum proteins. By means of Sephadex-G2000 column chromatography, it was possible to separate normal serum proteins from soluble B. bigemina and B. argentina antigens. When serum samples collected from cattle infected with B. bigemina and B. argentina were subjected to react with soluble antigens in the gel diffusion test a line of precipitation reaction was observed. Twenty-four or more hours of incubation was necessary for visible reaction.

Specific antibodies to B. bigemina and B. argentina were detected in sera of cattle infected with these parasites for 73 and 83 days of infection in the homologous system tested. An attempt was made to characterize these soluble antigens by means of immunoelectrophoresis. It was found that both antigens migrate a short distance to the positive pole. Antigenic reactivity of B. bigemina and B. argentina soluble antigens was preserved for 6 months at -79° C.

ADAMS, L. G.: A Study of the Toxicity of Imidocarb Dipropionate in Horses. (manuscript in preparation 1974)

An experiment was designed to study the potential systemic toxicity of imidocarb dipropionate in which 12 male and 12 female horses from 2 to 8 years of age were divided into 6 groups of 2 males and 2 females each. Five groups of 4 horses each were intramuscularly injected twice at a 24-hour interval with 2, 4, 8, 16, and 32 mg/kg, respectively. One group of 4 horses was injected intramuscularly with physiological saline solution and served as controls. Two of 4 horses injected with 16 mg/kg and 4 of 4 horses injected with 32 mg/kg died between days 2 and 6 following the first injection; therefore, the LD_{50} was determined to be 16 mg/kg at 21 days following the first injection. Increasing quantities of injected dipropionate correlated with increasing mortality rates, rapidity of mortality, systemic reaction, local injection site reactions, and increasing levels of serum urea nitrogen, increasing enzymatic activities of serum glutamic oxaloacetic transaminase, serum sorbitol dehydrogenase, serum creatinine phosphokinase, serum lactic dehydrogenase, a left shift in neutrophilic leukocytes, higher respiratory and pulse rate, and an increasing severity of hepatic renal and pulmonary lesions. The most prominent pathological lesions were an acute tubular necrosis of the proximal convoluted tubules of the renal cortex and an acute periportal hepatic lipidosis and necrosis. Death was attributed to renal and hepatic failure.

ADAMS, L. G. and CORRIER, D. E.: A Study of the Toxicity of Imidocarb Dipropionate in Cattle. (manuscript in preparation 1974)

An experiment was designed to determine the potential systemic toxicity of imidocarb dipropionate in which 20, 10 to 12 month old, calves were divided into 4 groups of 5 each. Three groups were intramuscularly treated twice at a 14-day interval with 5, 10, and 20 mg/kg, respectively, while the other group was treated only with physiological saline solution and served as a control. The LD_{50} at 14 days in calves receiving only one injection of imidocarb dipropionate was determined to be 15 mg/kg, and the LD_{50} at 67 days in calves receiving two injections was determined to be 15 mg/kg. None of the calves treated either once or twice at 5 or 10 mg/kg died, while 5 of 5 calves treated either once or twice at 20 mg/kg died within 18 days following the first injection.

No significant alterations occurred in the average daily gain, total serum proteins, total leukocytes, absolute lymphocytes, absolute monocytes, and absolute eosinophils. Increasing quantities of injected imidocarb dipropionate correlated with increasing levels of blood urea nitrogen, increasing enzymatic activity of serum glutamic oxaloacetic transaminase, and a left shift in neutrophilic leukocytes. In cattle treated with 20 mg/kg, the most prominent gross pathological lesions were hydrothorax, hydroperitoneum, pulmonary edema, perirenal edema, enlarged pale kidneys with prominent alternating red and white bands in the renal cortex, and enlarged, friable, pale livers with accentuating hepatic lobules. The most prominent histopathological lesions were acute tubular necrosis of the proximal convoluted tubules of the renal cortex and acute periacinar hepatic necrosis.

ADAMS, L. G. and TODOROVIC, R. A.: The Chemotherapeutic Efficacy of Imidocarb Dihydrochloride on Concurrent Bovine Anaplasmosis and Babesiosis. I. The Effects of a Single Treatment. Tropical Animal Health and Production (accepted for publication).

The chemotherapeutic efficacy of imidocarb dihydrochloride (3,3'-bis (2-imidazolin-2-yl)carbanilide dihydrochloride) administered as single intramuscular doses of 1.0, 2.0 and 2.5 mg/kg, against concurrent bovine anaplasmosis and babesiosis, is reported. Dosages of 2.0 and 2.5 mg/kg of imidocarb dihydrochloride rapidly inhibited acute ascending concurrent parasitaemias of Anaplasma marginale, Babesia bigemina and Babesia argentina; however, 1.0 mg/kg had a minimal effect on A. marginale, but was very effective against B. bigemina and B. argentina. Imidocarb dihydrochloride at 1.0, 2.0 and 2.5 mg/kg inhibited the development of immunity of the acute Babesia spp. infections, making the calves more susceptible to babesiosis upon challenge.

ADAMS, L. G. and TODOROVIC, R. A.: The Chemotherapeutic Efficacy of Imidocarb Dihydrochloride on Concurrent Bovine Anaplasmosis and Babesiosis. II. The Effects of Multiple Treatments. Tropical Animal Health and Production (accepted for publication).

Intact Anaplasma marginale, Babesia bigemina and Babesia argentina carrier calves treated intramuscularly 5 or 10 times with 2.5 mg/kg of imidocarb dihydrochloride at 48-hour intervals eliminated the Babesia infections, but not Anaplasma infections. The parasitaemias became microscopically undemonstrable within 4 days following the first treatment, and the packed cell volumes increased significantly within 18 days. Intoxications resulting in fatalities occurred in 5 of 6 calves given 10 intramuscular treatments of 2.5 mg/kg of imidocarb dihydrochloride at 48-hour intervals.

ALIU, Y. O., CAMP, B. J., DAVIS, R. H. and KUTTLER, K. L.: Studies on Imidocarb: I. Spectrophotometric and Thin-Layer Chromatographic Detection of Imidocarb in Biologic Specimens. Journal of Pharmacology and Experimental Therapy (submitted).

Imidocarb is a diamidine currently under evaluation for the treatment of babesiosis and anaplasmosis. Sensitive and highly specific spectrophotometric and thin-layer chromatographic methods for quantitative and qualitative determination of imidocarb in biologic specimens are described. Imidocarb is extracted under basic conditions from plasma, urine, milk, bile and homogenized tissue samples into organic solvents. Following extraction and concentration into acid, the drug strongly absorbs ultraviolet light in 3% HCl and can be qualitatively identified by thin-layer chromatography. Results can be obtained within 3-4 hours of receipt of a specimen and the detection limit for estimation of pure imidocarb in aqueous solution is 0.01 μg/ml, which is equivalent to a concentration of 0.05 μg/ml in plasma and 0.20 μg/g in tissue.

BISHOP, J. P. and ADAMS, L. G.: Babesia bigemina: Immune Response of Cattle Inoculated with Irradiated Parasites. Experimental Parasitology, (1974), 35: 35-43.

Effects of various radiation dosages on the infectivity and immunogenicity of Babesia bigemina were studied. Calves infected with 1×10^{10} B. bigemina parasitized erythrocytes exposed to 24 krad developed progressive parasitemias. Some calves receiving 1×10^{10} parasitized erythrocytes irradiated at 36 krad did not develop progressive infections. Progressive infections were prevented by exposure to irradiation at 48 and 60 krad. A degree of acquired resistance to infection with B. bigemina developed in calves after inoculation with parasites irradiated at 48 and 60 krad. The resistance developed was sufficient to suppress multiplication of the Babesia and to permit calves to survive otherwise severe clinical infections due to challenge with nonirradiated parasites. Irradiated parasites were frozen without apparent loss of immunizing properties.

CORRIER, D. E.: A Clinical, Histological and Ultrastructural Study of the Toxic Effects of Imidocarb Dipropionate in Goats. A Dissertation submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Doctor of Philosophy, August 1974.

The toxic effects of imidocarb dipropionate were studied in adult goats following the intramuscular injection of a lethal dosage of the drug. The acute clinical signs of toxicosis were transient and included excessive salivation, diarrhea, dyspnea, anorexia and inactivity. Significant increases in the mean serum urea nitrogen concentrations, serum glutamic oxaloacetic transaminase activities, and absolute neutrophilic leukocytes occurred. The most prominent gross pathological lesions were enlarged, pale kidneys with the presence of alternating red and white streaks in the renal cortex, hydrothorax, hydropericardium, ascites, and pulmonary edema. The histological alterations included severe acute tubular necrosis of the proximal convoluted tubules of the renal cortex beginning as early as 6 to 12 hours post-injection and massive pulmonary edema. Ultrastructural lesions were observed at 3 hours and progressed rapidly in the next 24 hours to include disruption of plasma membranes, dilation and proliferation of the endoplasmic reticulum, swollen electron dense mitochondria, and rarefaction of the cytoplasmic ground substance. Finally, complete disruption of the plasma membrane with fragmentation of the microvilli, loss of junctional complexes and cullular disjunction became evident from 12 to 24 hours post-injection.

Progressive decreases were observed in succinic dehydrogenase and adenosine triphosphatase activities beginning at 12 hours and 24 hours post-injection, respectively. The loss of ability of the epithelial cells of the proximal convoluted tubules to regulate cell volume was considered to have been the initial event responsible for the subsequent ultrastructural, histological and histochemical changes observed following the injection of imidocarb dipropionate.

GUZMAN, V. H., ADAMS, L. G. and GALVIN, T. J.: Verminosis Laringea Bovina Producida por Mammomonogamus laryngeus en Colombia. Revista ICA (accepted for publication).

Eight cases of bovine laryngeal verminosis were diagnosed in Valle del Cauca, Colombia, and confirmed by parasitological studies. Macroscopic and microscopic descriptions were made of the lesions caused by Mammomonogamus laryngeus.

KUTTLER, K. L.: Treatment of an Anaplasmosis Infected Herd Using Imidocarb (Dipropionate). (manuscript prepared for publication 1974).

A range herd of 469 cattle located in south Texas, near Laredo, was found to have an 82-88% Anaplasma infection rate. Treatment with 5 mg/kg imidocarb dipropionate (salt weight) was given each animal twice at a 2-week interval.

Treatment was followed by a marked drop in average complement-fixation (CF) titers, increase in average packed cell volume, and a complete disappearance of Anaplasma parasitemias. It is possible that infection may have been eliminated in as many as 75% of the animals treated, but a reinfection or recrudescent rate was such that a year later there was very little difference between pre-treatment incidence.

Treatment, while ineffective in eradicating infection, did show considerable therapeutic promise.

KUTTLER, K. L. and CRAIG, T. M.: Isolation of a Bovine Theileria. American Journal of Veterinary Research (submitted).

Dual infections of Anaplasma marginale and a Theileria resembling T. mutans were reproduced in splenectomized calves inoculated with pooled blood samples from east Texas cattle. Theileria can be obtained in pure form by treating cattle, with dual infections, with Gloxazone and imidocarb which eliminated Anaplasma but not the Theileria. These Theileria infections were responsible for mild, transient reductions in packed red cell volume.

KUTTLER, K. L., GRAHAM, O. H. and TREVINO, J. L.: The Effect of Imidocarb Treatment on Babesia in the Bovine and the Tick (Boophilus microplus). Research in Veterinary Science (accepted for publication).

Treatment of calves with 5 mg/kg imidocarb as dipropionate given intramuscularly 14 days before and 14 days after exposure to Babesia infected Boophilus microplus larvae rendered the next generation larvae incapable of transmitting Babesia infection. The drug, when administered to calves 14 and 28 days before tick exposure, prevented the development of clinical babesiosis, but the larval progeny of ticks reared on the calf treated 28 days before infestation were infective for Babesia. Treatment of a calf 42 days before exposure to infective larvae did not prevent the development of a Babesia parasitemia but appeared to reduce the severity of infection.

MAURER, F. D.: Support for Research in Animal Health. Journal of the American Veterinary Medical Association (accepted for publication).

The principle source of funds for research in the colleges of veterinary medicine has long been from agencies of the Federal government. In general, Federal agencies have placed emphasis upon human health related problems even though experimental animals and veterinarians were involved. As a result, there has been a relative neglect of those diseases of livestock which reduce U. S. production by 11 to 15% per year.

Rather than for the livestock industry to wait for government assistance, it is urged that livestock associations support research toward the solution of their own problems. Other industries find it economically profitable to plow back some 15% of annual profits into research and development; this could apply to livestock as well.

MAURER, F. D. et al.: African Research Capabilities. A 93 page report compiled as a member of a National Academy of Science Committee to render such a report for the use of USAID. (To be published June 1974)

PLATT, K. B.: The Development of an Indirect Fluorescent Antibody Test for Trypanosoma vivax in Colombia. A Thesis submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Master of Science, May 1974.

An indirect fluorescent antibody test for Trypanosoma vivax infections was developed for a survey involving over 2,000 cattle distributed throughout 11 departments and territories in Colombia. The antigen for the indirect fluorescent antibody test was prepared from the blood of infected calves by making thin blood smears that were air-dried and fixed in acetone: methanol: 60:40 at -20° C for 30 minutes. The antigen prepared in this manner was useful up to and including 144 days when stored at -70° C. Indirect fluorescent antibody test serum titers of 1:100 or greater were considered to be positive. No cross-reactivity of the indirect fluorescent antibody test was observed between Trypanosoma vivax and Anaplasma marginale, Babesia argentina, Babesia bigemina, Eperythrozoon sp. or Trypanosoma theileri at 1:50 serum dilutions. Suspicious reactions occasionally were observed when Trypanosoma evansi positive serum was diluted 1:50 and 1:100 and used in the indirect fluorescent antibody test for Trypanosoma vivax. The indirect fluorescent antibody test could be repeated within plus or minus one serum dilution approximately 80% of the time using different antigen lots on the same and different days. Samples obtained for the indirect fluorescent antibody test by eluting serum from dried impregnated filter paper discs produced results nearly equal to those obtained by using conventional serum samples. The indirect fluorescent antibody test was up to 20 times more effective in detecting Trypanosoma vivax positive cattle than the thick blood smear technique. The indirect fluorescent antibody test demonstrated the presence of Trypanosoma vivax antibodies in cattle from 5 departments in Colombia, while antibodies were not detected in the serum of cattle from 6 other departments of Colombia.

THOMPSON, K. C.: A Comparison of the Antigenic Properties of Erythrocytic Babesia bigemina in Acute and Chronic Blood Borne and Tick Borne Infections in Cattle. A Dissertation submitted to the Graduate College of Texas A&M University in partial fulfillment of the requirement for the degree of Doctor of Philosophy, May 1974.

This study was made to determine possible antigenic differences in a Babesia bigemina isolate in acute and chronic blood borne and tick borne infections of cattle.

On the basis of the serological results, antigenic variation within an isolate of B. bigemina occurred. Antigenic variation appeared to be influenced by the mode and duration of infection. The hosts' apparent reduced response to homologous challenge and the marked response observed with heterologous systems indicated antigenic differences of B. bigemina.

TODOROVIC, R. A.: Prevention and Control of Bovine Anaplasmosis and Babesiosis (Piroplasmosis). Proceedings of the Texas Animal Production Conference for Latin American Cattle Producers, January 21, 1974, College Station, Texas, (abstract).

The purpose of this report was to discuss the epizootiological similarities between anaplasmosis and babesiosis, and to emphasize recent developments concerned with prevention and control. In addition, the mechanism of immunity of these hemotropic diseases was discussed.

TODOROVIC, R. A.: Serologic Diagnosis of Babesiosis: A Review. Experimental Parasitology (submitted).

In the last three decades some fundamental knowledge concerning the immunoserology of Babesia spp. infections has led to the development of serologic techniques which provide a means for studying the pathogenesis of babesiosis and the detection of animals with subclinical infections. The antigens used in the serologic procedures originated from the parasitized erythrocytes, plasma, and tissues of animals with acute babesiosis. Parasitic and serum soluble antigens were applied in a variety of serologic tests, e.g., complement fixation, gel precipitation, agglutination, and fluorescent antibody, for detection of Babesia spp. antibodies.

In this review an attempt was made to summarize and discuss the recent advances in the serodiagnosis of babesiosis, together with conditions where the use of serologic methods may be valuable.

TODOROVIC, R. A., GONZALEZ, E. F. and ADAMS, L. G.: Babesia bigemina, Babesia argentina and Anaplasma marginale: Co-infectious Immunity in Bovines. Experimental Parasitology (submitted).

Forty-eight intact and 8 splenectomized calves were used to evaluate different systems of co-infectious immunization against Babesia bigemina, Babesia argentina and Anaplasma marginale. Co-infectious immunity was induced by two methods: (1) blood of calves acutely infected with B. bigemina, B. argentina and A. marginale was used as the source of inoculum and the post injection reactions were chemotherapeutically controlled with Imidocarb, Ganaseg, Gloxazone or Liquamycin; and (2) by artificially inducing babesiosis with the blood of carrier calves with chronic infections of B. bigemina and B. argentina without chemotherapy. The degree of resistance was determined by blood-borne and tick-borne challenges. Ticks were collected from cattle and identified as Boophilus microplus and Dermacentor nitens. Vaccinated cattle demonstrated a high degree of resistance to babesiosis and anaplasmosis; however, cattle without co-infectious immunity were treated chemotherapeutically to prevent death losses.

TODOROVIC, R. A. and KUTTLER, K. L.: A Babesiasis Card Agglutination Test. American Journal of Veterinary Research (accepted for publication).

A babesiasis card agglutination test (BCT) has been developed for detecting specific antibodies in cattle infected with Babesia bigemina. The agglutinating antigen was isolated from the blood of a splenectomized calf having 22% B. bigemina parasitemia. The antigen was preserved with 0.02% formalin and stained with fast green dye. The BCT was performed by adding 1 drop of antigen and 2 drops of plasma or serum on a card and mixing for 5 minutes by rotation. Agglutination was visible in instances of positive reactions immediately after rotation.

In cattle intentionally exposed to B. bigemina, the BCT detected agglutinating antibodies simultaneously with the onset of first parasitemia. This reaction was observed to persist as long as 3 months, or long after the disappearance of parasitemia. Because of its simplicity and apparent specificity, the BCT may have use as a field test to aid in the diagnosis of B. bigemina infections. The BCT results showed 100% agreement with the complement-fixation (CF) test on those serums prepared from blood collected within 3 months of infection.

TODOROVIC, R. A., LOPEZ, L. A., LOPEZ, A. G. and GONZALEZ, E. F.: Control of Bovine Babesiosis and Anaplasmosis in Cauca River Valley. Experimental Parasitology (submitted).

Experiments were carried out to evaluate two systems: (1) premunition and (2) chemoprophylaxis for the control of bovine babesiosis and anaplasmosis in the Cauca River Valley. Control of these diseases was achieved by inoculating cattle with virulent Babesia bigemina, Babesia argentina, and Anaplasma marginale and subsequent treatment with Imidocarb and Gloxazone to moderate the post premunition reactions. Chemoprophylactic treatment with Imidocarb and Gloxazone was administered to cattle before and during field exposure. Premunized cattle were highly resistant to tick-borne (Boophilus microplus) challenge. Imidocarb had therapeutic and chemoprophylactic properties against babesiosis, but appeared toxic. Gloxazone moderated the A. marginale post premunition reaction, but failed to prevent clinical anaplasmosis under the conditions of this investigation.

TODOROVIC, R. A. and TELLEZ, C. H.: The Premunition of Adult Cattle Against Babesiosis and Anaplasmosis in Colombia, South America. Tropical Animal Health and Production (accepted for publication).

Twenty-five cattle (Bos taurus) between 2 and 3 years of age were premunized with virulent Babesia bigemina, Babesia argentina, and Anaplasma marginale. The Babesia spp. premunition reaction was controlled by Imidocarb or by Ganaseg therapy. The A. marginale post premunition reaction was controlled by oxytetracycline alone, or by Gloxazone (dithiosemicarbazone) combined with oxytetracycline. Systems of premunition for Babesia spp. were found effective and practical; however, systems of premunition for A. marginale were found less effective and not practical under the conditions of these experiments.

PROPOSED WORK PLAN FOR GUYANA

The veterinary medical contribution to the AID/211D livestock consortium project in Guyana will consist in part of the survery outlined below. Samples will be collected from cattle located in the coastal plain, intermediate savanna and Rupununi regions of Guyana. Samples will be gathered in abotoirs and under field conditions. Laboratory work will be accomplished at the veterinary diagnostic labora' ~rv, Ministry of National Development and Agriculture, Georgetown, Guyana, or laboratories at the College of Veterinary Medicine, Texas A&M University (TAMU), College Station, Texas 77843, USA.

I. Survey of Bovine Parasites

A. Helminths

1. Gastro-intestinal tracts of approximately 90 head of cattle will be examined with emphasis on the abomasum, small and large intestines. These organs will be thoroughly washed in an effort to recover as many helminths as possible. An aloquote of the recovered helminths will be placed in 10 volumes of 100% formalin for processing at TAMU.

2. Livers and lungs will be examined for presence of helminths and appropriate samples recovered and treated as before for processing at TAMU.

3. Processing will consist of identifying helminth species and relative quantities and will be related to age, sex, breed, and origin of cattle from which collected.

Efforts will be directed toward vealer type cattle in the abatoirs and, if possible, field necropsys will be carried out on suitable natural deaths in young cattle.

B. Arthropods

Half body tick counts (of ticks 0.5 cm or larger) will be done on at least 200 head of cattle. Representative samples will be collected in 70% ethanal for identification at the Georgetown or TAMU laboratories. Other arthropod parasites observed to cause discomfort or injury to cattle will be collected, appropriately preserved and likewise identified.

Identification of arthropod parasites will be related to age, sex, breed and origin of cattle from which collected.

C. Hemoparasites

1. Anaplasmosis

Serum from at least 200 cattle will be examined by the Anaplasmosis card test at the laboratory in Georgetown.

2. Babesiosis

Serum from at least 200 cattle will be examined by the Babesiosis card test at the laboratory in Georgetown or complement fixation testing will be done where suitable antigen is available.

3. Trypanosomiasis

Wet mounts will be prepared and examined in the field for the presence of Trypanosoma spp.

4. Thick and thin blood films will be prepared and stained with Giemsa stain. These films will be examined for the presence of parasitemia and identification made when possible at the Georgetown laboratory.

Representative samples will be examined at the TAMU laboratories.

5. Packed erythrocyte volumes by the microhematocrit method will be done on at least 200 cattle at the Georgetown laboratory.

II. Survery of Bovine Reproductive Disorders

A. Brucellosis

Serum from at least 200 head of cattle will be examined by the brucellosis card test for the presence of reactors to that antigen, at the Georgetown laboratory.

B. When appropriate, samples for the cultivation of Trichomonas foetus will be taken and processed at the laboratory in Georgetown.

C. Appropriate specimens which might result in histopathological diagnosis of disease problems will be collected and preserved in 10% formalin.

III. Other Bovine Disease Problems

A. Tuberculosis

At least 100 head of cattle will be tuberculin tested by the caudal fold technique and examined for the presence of delayed hypersensitivity.

B. Clinical and post mortum examinations will be made where appropriate,and samples for processing at TAMU will be preserved.

C. Serums from at least 200 cattle will be inactivated at 56° C. for 30 minutes and processed at the TAMU laboratory for calcium and phosphorous levels. Other serology or chemistry will be accomplished if deemed necessary.

IV. Other Livestock

A. Equine

Blood will be collected in an effort to find morphological evidence

of Equine piroplasmosis and/or trypanosomiasis. Numbers examined will depend upon clinical evidence and case of collection.

B. Where time and facilities allow, other appropriate samples will be collected for processing in the Georgetown or TAMU laboratory. This will only be done at the specific request of the veterinary services on the Guyanese Ministry of Agriculture.

Budget for Dr. Craig's 211D Work in Guyana

May to August 1974

Round trip air travel to Guyana	$ 600.00
Local air travel in Guyana	600.00
Local car travel in Guyana	300.00
Per diem	2,500.00
Equipment	800.00
Supplies	500.00
Technical help	1,500.00
Estimated Total	$ 6,800.00

THE *IN VITRO* CULTIVATION OF *BABESIA BIGEMINA* UTILIZING BOVINE CELLS IN CULTURE

An *in vitro* cultivation system for *Babesia bigemina* would be very beneficial. The host specificity of *B. bigemina* currently limits research efforts due to the use of expensive cattle as experimental animals, and because of the difficulty of interpreting data obtained with a limited number of animals. An *in vitro* cultivation system used to study *B. bigemina* would contribute to our knowledge of the host-parasite relationship as well as adding important information concerning the life cycle of the parasite in the vertebrate host. Such studies could lead toward more rational methods of prevention, treatment, and chemotherapy of bovine babesiosis. *In vitro* cultivation of *B. bigemina* would be useful for the production of an effective vaccine or as an adjunct to premunition methods. The information acquired and the techniques developed during the present project could conceivably be applied to the study of other important hemoparasites.

In trying to develop an *in vitro* system for *B. bigemina*, various cells from both normal and infected bovines are being studied to evaluate their usefulness in such a system. Experiments have been carried out using bovine lymphnode, hemalnode, spleen, and kidney cells in culture. Due to preliminary results with the above cells showing them to be not suitable for such a system a decision was made to examine in depth a more natural *in vitro* cultivation system. Since the *B. bigemina* parasite normally grows in the erythrocytes of the bovine, it was decided to explore further the possibility of erythrocyte suspension cultures or other methods of erythrocyte maintenance *in vitro*. Preliminary results using special suspension culture flasks and media have been encouraging. We have been able to maintain erythrocyte-suspensions for seven to ten days; a time we felt would be sufficient to allow multiplication of the organisms. On further experimentation it was found that the organisms were unable to infect the erythrocytes and we are presently working on this problem. We now believe that while the suspension cultures appeared good as far as maintaining cell number the micro-environment may have been unsuitable. We have conducted experiments comparing this micro-environment in the live animal with the *in vitro* suspension system and have concluded that three specific areas need to be better controlled to create a more suitable micro-environment. These areas which need to be better controlled are the acid base balance, blood gas concentration of oxygen and carbondioxide, and specific nutrients mainly glucose. Currently we are conducting experiments to establish means to control parameters in these three areas within physiologic limits. Once able to control these environmental parameters better we will conduct experiments to infect erythrocytes in these controlled culture systems. If successful, we will work toward optimal conditions for the system and investigate a number of possible uses.

V

John Wyss

APPENDIX VI.

SUMMARY REPORT ON STUDY OF BLOOD-BORNE DISEASES OF CATTLE IN THE MARIANA ISLANDS (TINIAN AND SAIPAN)

June 1974

Prepared by: Dr. Radmilo A. Todorovic, Associate Professor, Institute of Tropical Veterinary Medicine and Department of Microbiology, College of Veterinary Medicine, Texas A&M University.

Subject: Visiting tropical zones in the Mariana Islands, U.S. Trust Territory (Tinian and Saipan), May 28 - June 16, 1974.

Purpose: To help organize the necessary research for control of hemotropic diseases in the Marianas.

Sponsor: This study was supported by the Trust Territory Animal Health Service and the Micronesian Development Company.

VI

Summary Report on Study of Blood-Borne Diseases of Cattle in the Mariana Islands (Tinian and Saipan)

I. INTRODUCTION

At the request of Dr. William B. Smith, Chief of Animal Health Services, Dr. R. A. Todorovic, Assoc. Professor, of Texas A&M University's Institute of Tropical Veterinary Medicine and Department of Microbiology, was invited to assist in developing a control program against tick-borne diseases in the Marianas. On the basis of previous observations, it was found that bovine babesiosis and anaplasmosis are a serious health problem of imported cattle, especially from blood disease "free" areas. This disease problem becomes very serious because of the presence of Boophilus microplus ticks in these areas (samples identified by USDA, 1969).

II. PROGRAM OF STUDY

May 30, 1974:

Dr. R. Todorovic arrived Guam. He was met at the airport by Dr. William Smith and later introduced to Dr. Walter Mestanza, Territorial Veterinarian for the Government of Guam. A short conference was held with Dr. Mestanza to discuss tick-borne diseases in the Marianas. In the afternoon, Drs. Smith and Todorovic had a conference with Mr. Ken Jones, owner of the Micronesian Development Company (M.D.C.) Ranch on Tinian. Late in the afternoon, Drs. Smith and Todorovic flew to Saipan.

May 31, 1974:

Dr. Todorovic visited the Animal Health Service Laboratory prior to flying to Tinian with Dr. Smith. Drs. Smith and Todorovic arrived on Tinian about 9:00 A.M. and were met by Mr. D. Conner, manager of the M.D.C. Ranch. Observations were made of all animals and representative samples (10% of total dairy herd) were taken for

serological and microscopic examination. Ticks were collected from infested animals for classification purposes. Some animals were treated against tick-borne diseases.

June 1, 1974:

Drs. Smith and Todorovic worked at the Animal Health Service Laboratory processing blood samples. Microhematocrits and microscopic examinations of Giemsa-stained blood films were made. Packed cell volumes (PCV) of all blood samples were determined. A record of this examination was made with special emphasis on animals with low PCV values. Animals with low PCV's were treated the following day. Dr. Todorovic visited all of the facilities used for veterinary activities. Detailed microscopic examinations of Giemsa-stained blood films which were prepared earlier revealed one animal which was infected with Babesia bigemina. This examination by Dr. Todorovic confirmed a previous diagnosis by Dr. Smith of Babesia in that animal. Photomicrographs were made of B. bigemina by Dr. Smith for permanent records. This is the first record of the presence of B. bigemina in blood films, although the diagnosis has been previously made by necropsy diagnosis and serological tests (serology-1974). Photographs of the Babesia will be used in training the Animal Health Service personnel to identify the parasite in the future.

June 2, 1974:

Drs. Smith and Todorovic visited Tinian in the morning. Observations were made of the imported and local animals. Discussions were carried out on the management of the herd. Drs. Smith and Todorovic returned to Saipan.

June 3, 1974:

Drs. Smith and Todorovic worked at the Animal Health Service Laboratory

examining Giemsa-stained blood films and prepared for the next visit to Tinian. All serum samples collected from anaplasmosis vaccinated animals had positive titers in a card agglutination test.

June 4, 1974:

Drs. Smith and Todorovic traveled to Tinian to observe imported animals, local beef herds, the swine production unit, and the slaughter facility. A conference was held with Mr. Ken Jones and Mr. D. Conner on the problems of tick-borne diseases of cattle and future development of the livestock industry on Tinian.

June 5, 1974:

Drs. Smith and Todorovic collected blood samples from the beef herd. Dr. Todorovic performed pregnancy examinations on 26 cows selected for slaughter. Three cows were pregnant; 1 cow had cystic ovaries; and 1 cow had an undeveloped genital tract with complete absence of ovaries and uterus. In the afternoon, Drs. Smith and Todorovic returned to Saipan. A splenectomy was performed on one imported calf to be used for blood inoculation. At the time of splenectomy, calf number 54 had a PCV of 31. Dr. Smith pooled the Tinian beef herd blood samples (20 samples) and intravenously injected 50 cc. of whole blood into the splenectomized calf to check for the presence of other blood parasites.

June 6, 1974:

Dr. Todorovic continued to work at the Animal Health Service Laboratory on the microscopic examination of Giemsa-stained blood films. Clinical examination was performed on the splenectomized calf. The following parameters were used: temperature, PCV, and parasitemia.

Temperature: 104.8 F
PCV: 31%
Microscopic: No parasites observed on blood films.

June 7, 1974:

Dr. Todorovic continued to work at the Animal Health Service Laboratory on the microscopic examination of Giemsa-stained blood films. Clinical examination of the splenectomized calf revealed:

Temperature: 104.0 F
PCV: 28%
Microscopic: No parasites observed on blood films.

June 8, 1974:

Drs. Smith and Todorovic examined the splenectomized calf and prepared Giemsa-stained blood films. Examination of the calf revealed:

Temperature: 106.6 F
PCV: 23%
Microscopic: A few ring forms of Babesia parasites were observed.

Anaplasmosis card tests were performed on the Tinian beef herd samples. Eighteen (18) of 20 samples were positive for anaplasmosis.

June 9, 1974:

Drs. Smith and Todorovic continued to work in the Animal Health Service Laboratory with special attention on the clinical and hematological examinations of the splenectomized calf. Examination of the calf revealed:

Temperature: 105.0 F
PCV: 15%
Microscopic: Microscopic examination of Giemsa-stained blood films revealed the presence of Babesia argentina (small form) in addition to B. bigemina (large form) which was previously described. This is the first time that B. argentina has been detected in the cattle of the Marianas. In order to observe the calf for other possible blood parasites, the calf was treated against babesiosis with 300 mg. of Ganaseg given intramuscularly.

June 10, 1974:

Drs. Smith and Todorovic worked in the Animal Health Service Laboratory photographing the B. argentina for future reference. Clinical examination of the splenectomized calf revealed:

Temperature: 101.0 F
PCV: 11.5%
Microscopic: No parasites observed on Giemsa-stained blood films. Splenectomized calf was treated a second time with 300 mg. Ganaseg given intramuscularly.

Drs. Smith and Todorovic met with Mr. Bermin Weilbacher, Chief of the Trust Territory Agriculture Division, to discuss the observations that were made during Dr. Todorovic's visit.

June 11, 1974:

Drs. Smith and Todorovic continued to work in the Animal Health Service Laboratory and examined the splenectomized calf prior to departing to Tinian for the day. Clinical examination of the splenectomized calf revealed:

Temperature: 101.0 F
PCV: 13%
Microscopic: No parasites were observed. The splenectomized calf died from babesiosis in spite of treatments with Ganaseg. This emphasizes the high pathogenicity of the Babesia species in the area.

On Tinian, Drs. Smith and Todorovic observed the imported dairy herd and gave the ranch manager instructions for continued observation of the dairy herd. The general condition of the dairy herd has continued to improve. This was characterized by gains in weight and general physical condition.

Drs. Smith and Todorovic returned to Saipan in the afternoon.

June 12, 1974:

Drs. Smith and Todorovic compiled this report and recommendations based on

observations made during Dr. Todorovic's visit. In the afternoon, Dr. Todorovic departed for Guam and a meeting with Mr. Ken Jones, owner of the M.D.C. Ranch.

III. ECONOMIC IMPORTANCE OF TICKS AND TICK-BORNE DISEASES IN THE MARIANAS

A. TICKS: It appears that ticks and tick-borne diseases are serious health problems to livestock in the Marianas. They are limiting factors for further development of the cattle industry in this area, especially when imported cattle are involved.

It is a well-known fact that ticks themselves can cause great damage to the animals by taking blood only. Some investigators have shown that adult female *Boophilus microplus* ticks can take from .2 to 2 ml. of blood daily. With 500 ticks on a calf, the animal could die from anemia due to blood loss. Excessive numbers of ticks can also cause retardation of growth in calves. In addition, certain substances produced during the tick's feeding on the animal can produce paralysis and other problems. Ticks feeding on animals also reduce the animal's resistance to disease.

On the basis of the above, it is essential to have adequate tick control for general development of the animals.

B. TICK-BORNE DISEASES: Since ticks are transmitters of many viral, bacterial, and protozoan diseases, their presence increases the chances of a disease spreading through the herd whenever one animal becomes ill. The economic importance of diseases is well established. The losses are attributable to death, loss in production, and cost of treatments. It is evident that two of the most important tick-borne diseases, bovine babesiosis and anaplasmosis, are present in the Marianas. (*B. bigemina*, *B. argentina*, and *A. marginale*)

The mortality rate due to these diseases can be 30-90% of the infected animals.

Animals which survive primary infection become naturally immune and resistant to infection. During the recovery, many pregnant animals may abort or have premature weak calves. Others may have problems which are difficult to overcome due to their weakened condition. Therefore, the control of tick-borne diseases is very important for the above reasons.

IV. RESULTS OF THE PRESENT STUDY

1. Identification of Ticks:

   A. *Boophilus microplus* were found present on imported and local cattle on Tinian and Saipan. These findings confirm previous reports.

   B. The microscopic examination of tick tissues revealed the presence of *Babesia* parasites. This fact proves that they are the principle vector of bovine babesiosis in the Marianas.

2. Identification of Blood Parasites:

   A. Microscopic examination of Giemsa-stained blood films revealed the presence of *B. bigemina* from the blood collected previously by Dr. Smith.

   B. Microscopic examination of Giemsa-stained blood films also revealed the presence of *A. marginale*.

   C. Microscopic examination of Giemsa-stained blood films from a splenectomized calf revealed the presence of *B. argentina*. The splenectomized calf was inoculated with 20 pooled blood samples obtained from the M.D.C. Ranch beef herd on Tinian. The first appearance of parasites was 67 hours after splenectomy. The calf will be examined until the appearance of *A. marginale* on the blood films due to the longer incubation period of this parasite.

3. Chemoprophylactic Treatments Against *Babesia*:

   A. All animals were injected with Imizol and were protected from *Babesia* infection for 5-6 weeks. This is in agreement with the manufacturer's literature on the use of the drug.

4. Other Observations on the Management of the M.D.C. Ranch Herd:

   A. Although a great potential exists for the development of the livestock industry on Tinian, there are several inadequacies which exist.

   B. No adequate facilities exist for tick control. Dipping vats should be constructed at each corral.

   C. Animals need to be divided into smaller groups, especially the imported dairy animals in order to be adequately observed for problems.

   D. Complete lack of records related to history, production, treatments, and weights of individual animals.

   E. Animals are allowed to wade into watering ponds. This increases the chances of a leptospirosis outbreak, parasitic infections (flukes, etc.), viral and bacterial infections. The ponds should be fenced immediately and water pumped to water troughs.

   F. Although nutritional requirements for the beef herd are probably adequate, a supplement feed should be provided for the young growing dairy animals if their full potential is to be realized, especially during the period of acclimatization, vaccination, and chemoprophylactic treatment against tick-borne diseases. This is especially important in the young pregnant heifers, because additional requirements are needed for the calf and development of their milking ability. This can also be applied to the young bulls which will be used for reproduction purposes.

G. Limited examination of animals destined for slaughter revealed 10% were pregnant and 4% had abnormal genital tracts. This indicates a necessity for the detailed examination of all animals in order to eliminate the nonproducers.

5. Recommendations:

A. Improve nutritional and sanitary conditions of the imported animals.

B. Repeat the chemoprophylactic treatment of imported heifers between June 22-29. Each heifer should receive Imizol at the dose rate of 1 cc. per 100 lbs. body weight.

C. Give booster dose of killed Anaplaz vaccine at the same time as the Imizol to reduce handling of the animals.

D. Special care should be taken in handling the pregnant heifers. Avoid rushing, crowding, and handling during the heat of the day. They should be divided into small groups and treated in early morning or late evening.

E. During handling, individual observations should be made and recorded on each animal as to presence of ticks, lesions, or other physical disabilities. Animals with problems should be segregated for treatment.

F. Individual cases which show fever should be treated with a combination of Ganaseg and Terramycin according to doses previously described.

G. For future importations of cattle, animals should be vaccinated with local strains of Babesia and Anaplasma immediately upon arrival. The vaccine can be prepared by the Animal Health Service Laboratory on Saipan.

H. General insect (fly and other arthropods) control needs to be improved as biting insects serve as both biological and mechanical vectors of anaplasmosis. This can be accomplished with special sprays or back-rubbers for the cattle.

V. ACKNOWLEDGEMENTS

This study was supported by the Trust Territory Animal Health Service and Mr. K. T. Jones, owner of the M.D.C. Ranch.

Special thanks for assistance and hospitality are given by Dr. Todorovic to Dr. William Smith, Thomas Dela Cruz, and Roman Guerrero of the Animal Health Service.

Cooperation and assistance by the M.D.C. Ranch manager and personnel were appreciated.

cc: Chief, Animal Health Service
Mr. K. T. Jones, Jr., owner M.D.C. Ranch
Mr. D. Conner, manager M.D.C. Ranch
Dr. F. D. Maurer, Assoc. Dean, Texas A&M University
Dr. L. C. Grumbles, Prof. & Head, Dept. Microbiology, Texas A&M University

211d ANNUAL REPORT
July 1972-June 1973

Grantee:

Institute of Tropical Veterinary Medicine
College of Veterinary Medicine
Texas A&M University

Title: "Expanding Competence in the Design & Execution of Livestock Development Programs in the Tropics, Emphasizing Ruminant Livestock Production Systems Through Improved Breeding & Disease Control" AID/csd-3675

Grantee: Texas A&M University
College Station, Texas
1/2 to Institute of Tropical Veterinary Medicine, College of Veterinary Medicine and
1/2 to Animal Science Department

This 1/2 of the report is for the Department of Animal Science

Director: T.C. Cartwright

A. Statistical Summary:

Period of Grant: 1 July 1972 to 30 June 1977
Amount of Grant: $250,000. to the ITVM, Department of Animal Science

Expenditures:	For current year 1973-74,	$71,987.14
	Accumulated,	94,884.29
	Anticipated for next year,	55,000.00

B. Narrative Summary:

Major effort has been continued on the development and validation of a beef cattle production model at the herd level. A reproduction component was completed and an integrated forage model was begun. The completed components have been tested for validation and all now respond well. Data collection was completed in Guyana and organization begun for further use in validation and for use in examining alternative management practices. Extensive data were also collected in Brazil for use in validation and examining methods of improving production efficiency. (See Appendix I and II.)

The syllabus and teaching aids for the comprehensive college level course in Tropical Beef Production were extended and near completion. Extensive material has been developed for use as teaching aids by the instructor and directly by the students. The decision was made to publish this material in some printed form. All material will be made available to any institution engaged in teaching a course for which this material is appropriate. It is anticipated that a course at Texas A&M University will be developed around this material. Seminars were also continued in this area. (See Appendix III and IV.)

An observation and information gathering tour was completed in Sahelian countries of Africa. These countries were Mali, Cameroon, Upper Volta and Chad. Emphasis was placed on determining: (1) the most useful syllabus for a seminar for livestock officers of these countries and (2) the components of beef cattle production systems practiced. Emphasis was placed on the second point in the context of of the adequacy of our current production model and its utilization in examining the nomadic production practices and feasible alternatives to uneconomic or otherwise unsound practices. Also a conference on "Tropical America: Potential to Increase Beef Production" was attended at CIAT Cali, Columbia where assistance was given to program development. Seminars or talks on tropical beef production were developed or given on request in Mexico, Costa Rica and Texas and at a Symposium organized by the International Animal Agriculture Committee of the American Society of Animal Science (See Appendix V and VI.)

The staff and graduate students whose activities were fully or partially supported under this grant are Dr. T.C. Cartwright, Dr. J.C. Miller, Dr. G.E. Joandet, Dr. J.D.G. Steenkamp, Dr. D.E. Farris, Dr. A.J. Dye, Dr. D. DeMichele, T.T. Voelkel, F. Gomez, J.M. Davis, J.R. Simpson, J. Humber.

C. Detailed Report:

I. General Background and Purpose of the Grant

The application of improved techniques and methods of ruminant livestock production in developed countries have evolved over a period of time and have usually been based on research conducted within the context of prevailing conditions. The adaptation of these techniques to LDC's has proven to be a complex problem because of the inter-relationships which exists among the various subdisciplines within animal science and because social, economic and climatic constraints not common to developed countries often significantly and unfavorably alter outcome projected on a series of *ad hoc* considerations. Technical developments within these subdisciplines must be applied within the context of prevailing conditions and with simultaneous consideration of other inter-related effects. A systematic, organized method of examining these effects at the herd level and application of this method to tropical settings is the primary objective of our efforts.

II. Objectives of the Grant

1. Objectives restated

The broad objective of the consortium is to strengthen capabilities through an integrated multidisciplinary approach to:

a) identify opportunities for significant ruminant livestock production.
b) analyze constraints to such development.
c) design programs to overcome constraints and exploit opportunities for developing the ruminant livestock industry.

The objectives for the Animal Science Department at Texas A&M University are to improve competency relating to livestock breeding and selection as a component of livestock production and marketing in LDC's and to develop and evaluate livestock production systems within the constraints and potentials of tropical environments, particularly those of alternating wet and dry seasons at low altitudes. This objective includes the evaluation of different systems which are intuitively designed based on existing knowledge and in consultation with members of the consortium and to identify the major constraints at the herd level to increased production. The Animal Science Department will develop its capability of teaching undergraduate and graduate students beef cattle production which is directly applicable to tropical LDC's. Adult education will be included.

2. Review of Objectives

After delays experienced during the first year of the grant, this, the second year, has profited from these experiences and increased activity so that accomplishments are on or ahead of schedule. There have been no changes in the objectives except minor operational adjustments.

III. Accomplishments in our 211(d) Program include the following:

1. Information Exchange

T.C. Cartwright and G.E. Joandet participated in seminars sponsored by CIAT in Cali, Columbia entitled Tropical America: Potential To Increase Beef Production, February 18-21, 1974. Joandet coordinated a work group on reproduction and genetics and developed a report resulting from this work group on potentials (See Appendix VI.)

Invited seminars from outside visitors on tropical beef production presented during the year were (see Appendix IV).

Simulation Of Animal Functions In Models Of Production Systems: Ruminants On The Range, Dr. R.W. Rice, University of Wyoming.

A Dynamic Beef Cattle Herd Model, Joe Humber and G.E. Joandet, Texas A&M University and Instituto Nacional Technilogia Agropecuaria, Argentina.

The Relationship Between Size And Production Efficiency Of Africander Cattle In Rhodesia, Dr. J.D.G. Steenkamp, Ministry of Agriculture, Rhodesia.

Crossbreeding In Tropical Venezuela And Bolivia, Dr. Dieter Plasse, Professor, Veterinary Science Faculty (Leader, Genetics Group), Central University of Venezuela, Maracay, Venezuela.

Current Research In Cattle Breeding In Ireland", Dr. E.P. Cunningham, The Agricultural Institute, Animal Production Research Centre, Dublin.

Beef Production In Colombia, Fernando Gomez,

T.C. Cartwright observed beef cattle production systems and conferred with livestock officers in the Sahelian area of Africa in the countries of Mali, Upper Volta, Cameroon and Chad. Also extensive conferences were held with Dr. Andre Robinet Chief of the Livestock Department of the French Ministry of Foreign Affairs. (See Appendix V.)

Dr. G.E. Joandet presented several seminars and conferred with producers and livestock officers in several countries. The seminars were:

Curso Intensivo en Produccion Animal con Enfasis en Bovinos - Turrialba, Costa Rica

Selection of Purebred Herds, Possibilities, Objectives and Consequences - Monterrey, Mexico

Systems Of Beef Production, Their Principle Factors - Monterrey, Mexico

2. Modeling beef production systems

The development of a model that would simulate beef production for the tropical conditions has been one of the objectives of the Consortium and such responsibility was taken by Texas A&M University. Dr. G.E. Joandet devoted full time to model development and two graduate students, Joe Humber and Jim Sanders devoted nearly full time to this activity. Dr. T.C. Cartwright, Dr. D. DeMichele and Dr. W.C. Ellis devoted 10% of their time. Several additional graduate students are involved.

The model was divided into submodels for the developing process. The submodels are: (1) composition and dynamics of the herd, (2) flow of nutrients (3) nutrient production of forages, (4) reproduction and (5) economics.

The model objective is to simulate the production of beef for a defined set of environmental conditions and for given levels of resources. The primary objective of the simulation will be the physical relationship between input and output variables that will allow the economic evaluation as a second step.

Herd Composition and Dynamics

The herd composition submodel that describes the dynamics of herd composition has been completed. It is possible to predict the age structure of the herd given the initial composition and a set of parameters related to fertility, survival rate and management policy. Decisions such as numbers of animals to be sold, which ones to sell, culling practices, terminal age, etc. can be evaluated by use of this submodel.

This submodel is particularly useful in predicting possibilities of cattle population growth for areas to be developed for beef production. The simulation procedure of herd structure has been written so that it is very general and may be used with any set of environmental conditions. However, it will interact with the other parts of the model which will have influence on some of the constrants used by this submodel and is a direct function in many ways of the reproduction component.

Nutrient Flow

This submodel has been completed and describes the use of nutrients of each of the individuals that compose the population; requirements have been defined on a prioritory sequence according with different biological functions of the individual under consideration. Requirements to fulfill those functions are based on present knowledge and therefore they were computed on the basis of current recommendations. This submodel allows the system to store and withdraw nutrients of the body as a dynamic process. It is designed for use under a wide set of environmental conditions.

Reproduction

An initial model has been completed and validated with two sets of independent data. Even though it responds well, further modifications are planned in order to accomplish further "fine Tuning." The present stage of development is reported in detail in Sanders, J.O. 1974. A Model Of Reproductive Performance In The Bovine Female. M.S. Thesis, Texas A&M University, College Station. This model is based on nutrient quality and availability as reflected in weight change and characterization of age, time lapse and weight potential. (See Appendix VI.)

Nutrient Production

The details of this submodel have not been completed, but work is well underway. It is intended to describe the quality and quantity of forage produced for a given set of environmental conditions.

3. Syllabus For Course Beef Production In The Tropics

"More than half the human race is either undernourished or malnourished.....When we consider that in the twentieth century one child out of three is born without any chance of living a normal life, we are forced to conclude that out civilization is mutilating its human resources and reducing its chances of progress."

"It is intolerable that the vast reservoir of knowledge and wealth which exists in the world is hardly being used for improving the lot if the many who are desperately in need of it. Of the several wants of man, food is primary. Hunger and malnutrition can impede the progress of a nation".

These quotations are from the opening statement issued in Rome in 1963 by 53 prominent world leaders including a number of Nobel Prize winners. This historic document concludes with the following:

"We desire to state with all the emphasis at our command that freedom from hunger is man's first fundamental right. In order to achieve this, we suggest urgent and adequate national and international effort in which the governments and the peoples are associated.....We feel that international action by abolishing hunger will reduce tension and improve human relationships by bringing out the best instead of the worst in man".

The world's chronic undernourished and malnourished peoples are largely in the "developing countries" most of which are in the tropics. The solution appears to be one of helping these peoples to develop and to utilize their great wealth of natural resources. The problem is not so much a lack of food as it is a lack of knowledge about food.

The tropics have tremendous resources in land, forage and cattle, yet their productivity and utilization is only a fraction of their potential. Any increase in the level of production of beef and milk will help to reduce the severe animal protein deficiency in the diet of tropical children.

It is our belief that a course on "Beef Production in the Tropics" must of necessity place considerable emphasis on developing an appreciation for and hopefully some understanding of the many and complex problems of the tropical environment, its peoples, their culture and traditions. The problems are not only climate, but the effect of climate on soils, vegetation, animals and man himself. In addition, the wide variety of tropical environments affected by temperature, rainfall, altitude, prevailing winds and land masses create specific problems peculiar to a given area. The tropical environment is much more varied and complex than is the temperate climate environment.

Animal characteristics which enable then to tolerate the tropical environment with emphasis on the physiology of body temperature regulation must of necessity be stressed.

Methods of improving the environment by providing supplemental feed, improving pastures, reducing losses from parasites and diseases will be included but will vary with the specific environment.

Genetic improvement of native cattle by selection, introduction of new stock or by AI offer avenues of progress and are included, with use of examples where such data are available.

Surveys of available tropical feed stuffs, and evaluation of native and adaptable introduced forage have been reviewed.

Problems of credit, transportation, communication, lack of refrigeration, dietary habits and traditions will be discussed.

Liberal use will be made of visual aids showing climates, soils, vegatation and cattle of the tropics. A substantial reference list which has been developed will be included.

It is impossible to predict at this time the number or background of students who will be enrolled in this course, but one thing we are certain of - the course will be and should be revised and updated annually. The syllabus is approximately 90 percent completed as of this date. Tentative plans have been made to publish these materials.

A copy of the proposed course outline is given in Appendix III.

4. Training

T.T. Voelkel has completed all course work and will complete all other requirements within two months for a Master of Agriculture in Animal Science in the area of tropical beef production. He has accepted a position in Botswana closely related to his training. His 7 years experience in Kenya has been especially valuable as a frame of reference for a continuing critique on development of the beef production system model for application in an LDC.

J.O. Sanders completed an M.S. degree in beef production system; his thesis is entitled "A Model Of Reproductive Performance In The Female Bovine". He will continue work with the entire model and will assume the duties of Dr. G.E. Joandet in September 1974.

J. Humber completed a Ph.D. degree in operations research; his dissertation is entitled "Application Of Decision Theory To Alternative Policy Selection And Range Science". His training was used largely in supplying expertise in programming in Dynamo and in decision theory.

F. Gomez, formerly National Director of Programs for Beef Cattle, Ministry of Agriculture, Colombia, has completed a year of Ph.D. training in systems livestock production. His research problem will deal with the use of cows to produce calves and milk for human as is typically done with the majority of cattle in the tropics.

J.R. Simpson completed a Ph.D. degree in Agricultural Economics. His dissertation is entitled "International Trade In Beef And Economic Development Of Selected South American Countries", Dr. Simpson has accepted a position as Marketing Economist Cooperative League of U.S.A. USAID/Chile, American Embassy, Avenida Agustinas 1343 Santiago, Chile.

Dr. G.E. Joandet completed 18 months of intense study, research and development of beef cattle production systems models. He has published and lectured on this topic in the U.S. at International Symposia, Colombia, Costa Rica and Mexico. He will return to Argentina to apply his expertise in systems production in October 1974. (See Appendix VI.)

5. Expenditures July 1, 1973 to June 30, 1974

Salaries	$42,884.56
Graduate Assistantships	6,300.00
Travel and Allowances	18,580.50
Communications, Library, etc.	214.84
Equipment	0.00
Data processing, publication, etc.	4,007.16
	$71,987.14

IV. Impact of Grant Support Activities in Developing Institutional Capabilities

The development of a systems model for beef production in the tropics has had the effect of bringing together the various subdisciplines in Animal Science to provide input information. In the process, a greater appreciation has developed in the staff for the various interactions among the areas of their expertise and the effect of these interactions on production especially as the peculiar qualities of the tropics are improved along with other constraines common to LDC's

Because of our development in the area of systems beef production, we were invited to present a special seminar for the U.S. Meat Animal Research Center (MARC) Clay Center, Nebraska. As a result, a formal, cooperative agreement between MARC and the Texas Agricultural Experiment Station was initiated and signed in May, 1974. (See Appendix VII.) This agreement entitled "Simulation Of Beef Cattle Production Systems" is a substantial spin-off benefit of this 211(d) grant. The intense beef production problems of the LDC's which are compounded by additional problems of a tropical climate in the past have been almost impossible to bring into focus for application of technology and have forced a more formal, organized consideration of the system. A systems approach would not likely have developed independently in the U.S. at this time.

This grant has specifically allowed staff to travel to tropical countries to observe, to participate in conferences directed toward tropical livestock production, to develop a comprehensive course specifically on tropical beef production, and to attract students with experience and interest in tropical countries.

V. Utilization of Institutional Resources in Development

The expertise of the Data Processing Center, Operations Research Group, and Institute of Statistics were necessary for model development. Data from the Texas Agricultural Experiment Station (TAES) were necessary for validation. The direction and objectives of the TAES research project entitled "Evaluating Hybrid Systems For Total Efficiency Of Beef Production" have been revised in some instances to supply data and information specifically required for the model development.

VI. Other Resources For Grant Related Activities

The physical facilities including office space and equipment for staff and graduate students, telephones, data processing center, secretarial staff, liberary, etc. have all been contributed without reimbursement (except for computer time). However, the major contribution has been the availability of staff for consultation with sponsored graduate students and personnel working an systems model development. For example, it is estimated that

personnel in the ruminant nutrition section contributed the equivalent of about 1/2 professional man year to our model development. The animal breeding and genetics section has contributed a similar or greater amount. The reproductive physiology, meats, dairy and management sections of the Animal Science Department have contributed lesser amounts. Operations Research, Range Science and Agricultural Economics have also participated and aided our efforts.

VII. Next Year's Plan of Work and Anticipated Expenditures

Primary effort will be placed on completion of the forage component and addition of the economic component of the beef production systems model and completion of the syllabus for the tropical beef production. course. It is anticipated that a number of production alternatives for several tropical settings will be examined. These include Guyana, Brazil, Uganda, Rhodesia and Texas. Also, it is anticipated that the course in tropical beef production will be submitted for approval as a regular course at Texas A&M.

Activities similar to those during the past year will continue in publication, presentation at seminars, sponsored visiting lectures, graduate students and the Latin American Symposium on Livestock Production will be continued.

The budget for July 1, 1974-June 30, 1975 is:

Salaries	$26,300
Graduate Assistants	12,000
Travel and Allowances	9,000
Communications, Library, etc	200
Equipment	1,500
Data Processing, publications etc.	6,000
TOTAL	$55,000

TABLE 1

Distribution of 211(d) Grant Funds and Contributions From Other Sources of Funding[a]

Review Period 1 July 1973 to 30 June 1974

(List all grant related activities	211(d) Expenditures				Non 211(d) Funding Amount
	Period Under Review	Cumulative Total	Projected Next Year	Projected to end of Grant	
Research[b] (Development)	51430	65044	38850	150000	42000
Teaching	10303	17503	12000	72000	6000
Libraries	214	249	200	1000	5000
Consultation[c]	9290	9290	2000	18000	
Publication	100	100	1200	2500	7200
Other	650	2698	750	6500	20000
TOTAL	$71987	$94884	$55000	$250000	$80200

[a] These figures are best estimates

[b] This research category relates more to developing competence and is not research in the usual proper sense.

[c] Some teaching and other activities have been changed to this category from earlier budget - this is only a classified change.

TABLE II

Expenditure Report (Animal Science)*

(Actual & Projected)

Under Institutional Grant #AID/csd-211d 3675

Review Period 1 July 1973 to 30 June 1974

Budget Items	Expenditures to date		Projected Expenditures			Total Budget
	Period under Review	Cumulative Total	'74-'75	'75-'76	'76-'77	
			3	4	5	
Salaries	$42885	$53316	$30000	24000	$24184	$131500
Travel	18580	23989	8500	5000	4311	41800
Equipment	0	1245	800	700	455	3200
Libraries	215	248	200	400	152	1000
Supplies, data processing, publ.	4007	5013	3500	4400	4587	17500
Graduate Assistantships	6300	11073	12000	16000	15927	55000
TOTAL	$71987	$94884	$55000	$50500	$49616	$250000

A Model For Simulation Of Beef Production[1]

APPENDIX I

Guillermo E. Joandet[2]

During recent years several models for describing total of partial aspects of beef production have been used. The objectives of developing models are wide; in general they are constructed to increase the understanding of a given system and to evaluate the effect of individual variables in the final output. Models can be constructed at different levels, going from cell components to biological systems, all of them however do share a common element, that is the need for a logical and systematic description of the process one is dealing with. Such descriptions force those who are building the model to search for all available information on each of the steps and therefore to be aware of the lack of it whenever it is not present. It is a synthesis process and as much the end product is a consequence of the inputs. The more detailed and accurate the information we feed the model, the closer to reality is the answer we obtain. Theoretically it might be possible to describe a system of beef production with a model starting from very basic elements at the molecular level going into all the biochemical reactions that take place in the process and taking into consideration effects of the environment. Unfortunately such a model is almost impossible to construct nowadays, because of lack of knowledge and operational costs.

---

[1] Presented at the Annual Meeting of the NC-1 Technical Committee July 23-24, 1974, East Lansing, Michigan.

[2] Research worker of INTA, Balcarce Exp. Stat., Argentina. At present time: Visiting Assoc. Prof. of Animal Science at Texas A&M University.

Acknowledgement: The valuable discussions and encouragement of Dr. T.C. Cartwright during the construction of the model is greatly appreciated as well as for his critical review of the manuscript. Sincere appreciation to Mr. J.O. Sanders for his comments on the manuscript.

Therefore we have to think of describing the system at a much higher level where we might be able to deal with variables that make the system react and also that would be operationally feasible.

The Animal Breeding Group at Texas A&M University has been working on models of beef production for the last 8 years. Models, for describing partial aspects of beef production have been used, all of them were entirely deterministic; that is, no variation due to chance was allowed. In general, stochastic variables have not been included in models of beef production.

The work that we are doing at the present time is directed toward the description of the system at the herd level. In order to do that we have to build the model at the individual or organ level. The relationships used are the ones found in the literature and whenever there is a lack of them we are developing equations, usually empirical, to describe the process following some kind of logical procedure.

Conceptual Development - The first step that was taken was to describe the herd itself. A herd is composed of cows and bulls that through the function of reproduction have offspring. The calves by the function of growth reach weaning time (age at this time is a variable). Weaning time is important to describe because decisions usually are made then: selling policy of calves, growing of those that remain in the herd, etc.

After weaning, through growth again, we reach the age where decisions are made about the future of the animals; some of them are used as replacements, others are sold for reproduction or as slaughter animals. Possible outputs of the herd are animals that have reached reproductive or slaughter age. Losses due to death might occur at any age.

As mentioned there are two functions that make the dynamics of the herd possible: reproduction and growth. Growth can be divided into preweaning and postweaning phases since some of the variables that are involved in one period are not necessarily present in the other. With the same criterion, postweaning growth can be divided into different phases to take care of the possible steps that the growing animal follows after weaning and before it leaves the herd or is used as a replacement.

If we now take both of these functions, it might be possible to make a list of the most important variables that modify or have an influence on them. Let us consider reproduction, first.

The level of reproduction of the herd depends on the reproductive performance of females and males. Female reproductive performance is influenced or determined by: age of cow, genotype, age at which puberty is reached, presence of calving difficulties, stage of lactation, incidence of diseases, level of nutrition, use of artificial insemination, other environmental effect, etc. The male reproductive performance will be related to age, genotype, use of artificial insemination, level of nutrition, presence of diseases, number of females per male and other environmental variables. Some of the variables will have direct effects, some of them will interact in order to modify reproductive performance, some of them are related with one sex and some with both. Considering preweaning growth we might list the following variables: sex of calf, birth weight, dam's milk production, age of dam, maternal ability, dam's genotype, sire's genotype, level of nutrition, presence of diseases, other environmental effects. For the postweaning growth we might

consider one or several phases of growth. Each of these phases will be influenced by: growth during previous phase, genotype, sex, level of nutrition, presence of disease, other environmental effects.

If we take each of the variables we mentioned as explanatory it might be possible to find others that can explain or, in other words, to be functions of others, which are at a lower level. Let us consider nutrition as an example; it can be described in terms of availabilities and qualities of minerals, water, forage, supplemental feeding which sometimes might include vitamins. Forage production, could be a function of type of soil, temperature, rainfall and/or irrigation, altitude, fertilizers applied, grazing systems and harvesting. Grazing systems might depend on types of animals, stocking rate, stocking pattern, etc.; it interacts with pasture production and harvesting. Supplemental feeding would depend on the availability of grain, nonprotein nitrogen products, industrial byproducts, harvested forage, etc.

It is possible to keep on going and make a larger, more complete list of variables and to find the mathematical relationships among them. What was described so far was the way the model was conceptually developed. Certainly is not easy to put all these things together.

Actual Development Of The Model - In order to construct the model it was divided into three portions or submodels: herd structure, individual nutritional requirements and nutrient production. Recent development of a reproductive performance model and application of optimization techniques will be added to the original model and will make it more complete and general.

Herd Structure - The herd structure submodel describes throughout time the number of different individuals present in the herd at a given time. The composition depends on fertility levels, mortality rate and policy of selling or buying (migration).

At breeding time there are lactating and nonlactating females for which there is a probability attached to each individual to come into heat; this of course is not a random process.

The submodel describes the female population, since males are assumed not to be a limiting factor.

Those not coming into heat will be dry next year, those that showed heat will be mated; of these some are going to get pregnant the others will be dry. Of those pregnant, some will abort and will be dry; the others will give birth. From these, some will loose the calf and be dry; the rest of them will be nursing calves during the breeding season. The probability at each of these steps is associated with the age, genotype and past and present nutrition of the cow. Decisions on selling policy can be applied on the dry cows or nursing cows so that they may be bred or may be sold; calves can be weaned at variable ages, and after weaning they can be sold, kept so they reach reproductive age, or sold as steers or replacement heifers or bulls. Probabilities after weaning are independent of age of dam. Different weaning ages can be considered as well as age at which females have their first and last calf.

Originally the model was considered for a three-month breeding season, but later it was extended to any length between three and twelve months. For the three-month situation, a probability distribution of birth was developed, based on observed data. The corresponding

cumulative distribution shows that by 30 days of the calving season 52% of the calves are born; by 60 days, 86% and by 90 days 100%. These figures are very close to what one might expect them to be.

For a fixed set of probability figures and a given policy of management, if the model is run for a long enough period it will reach a steady state of equillibrium situation. The equillibrium situation can be computed using a Markov's process of the probability of a female of a given age to be in the herd next year. We will use this approach to validate the submodel.

Nutritional Submodel - Under the assumption that energy will be the limiting factor it was decided to use the energy system in order to establish requirements of the animals. Requirements were divided into: vital activity; pregnancy; milk production; maintenance and gain of weight. Vital activity was defined as the energy requirement in order to keep the animal alive; this will be equivalent to basic metabolic needs plus the energy required to obtain that amount. Maintenance will be the energy required besides that for vital activity, in order to maintain constant body weight.

The vital activity portion was included in the model since we know that some production functions (milk and pregnancy) are carried below maintenance levels; that is with females loosing weight. The traditional way of defining maintenance is to have both things together which is an instantaneous concept; however, from an operational point of view we have to divide it. By separating the requirements this way we will be able to establish priorities for the use of energy for the different functions. Let us say we have a milking

pregnant cow gaining weight and we start decreasing the amount of energy intake. The reaction of this individual as intake is lowered will be to stop gaining weight, to start loosing weight, to stop milk production, to abort (these last two might be in the reverse order) and finally to die. If this sequence is true there is a priority for the use of energy and the model should account for it.

A fairly large amount of time was spent on the discussion of what energy system to use (*); even though the net energy system might be the ideal one, the metabolizable energy system could be more practical. Since there is almost a constant relationship between metabolizable and digestable energy both systems can be considered equivalent so we are using either one according to the information abailable.

For growth and maintenance requirements, the National Research Council (1963) recommendations are used. Some work has been done on determining the requirements of milk production and pregnancy. For milk production requirements, data from the Agricultural Research Council (1965) recommendations were used. The amount of milk produced in these tables is a function of metabolizable energy consumed. It is recognized that the function is different for different energy concentration in the diet and also varies with genotype. Three genotypes are presented with different levels of milk production and fat content of the milk. If the regression of energy consumed on milk produced is studied, it is possible to see that variation between diets within genotypes and between genotypes is not too large. Therefore

---

*The participation and suggestions of Dr. W.C. Ellis in these discussions is appreciated.

it is possible to conceive that an intermediate value could be a good approximation for beef cattle; particularly if we think that a wide range of genotypes were represented (this goes from a 363 kg live weight Jersey producing milk with 4.89% fat to a 590 kg Friesian cow producing milk with 3.58% fat). The average metabolizable energy required to produce 1 kg of milk is close to 1400 kcal. Daily milk production requirements can be computed with this relationship. It seems that milk production declines from shortly after birth according to most estimates in beef cattle; it seems reasonable to think that the decay follows an inverse exponential function. Such a function was fitted to experimental data from McGregor and a similar exponent for Angus x Jersey cows and Hereford cows were found. The function was of the type:

$$MP\ (kg/day) = ke^{-bt}$$

where k is the value of maximum milk production and t is the time after that maximum was reached. The constant b was 0.087 in the first case and 0.081 in the second, which are very close.

Milk production is affected by age of the cow, having its maximum some way between 5 and 9 years of age. The correlation factor could be obtained with a quadratic equation that gives a parabola. The equation we found was:

$$CF = 1 + 0.002166\ (A-7) - 0.004034\ (A-7)^2$$

it is not intended to be used beyond 13 years of age.

I do not think it is necessary to go into detail of all of the steps in the development of the pregnancy requirements. Where we started, a total given by the NRC was considered; but since it was necessary to have monthly requirements, first an expotential function

of birth weight and time was used and finally by adapting recent work done on sheep (Rattray et al., 1974) it was possible to develop a growth function for the concepts. The integral of that function between any given period gives the pregnancy requirements. One interesting (and somewhat controversial) observation which has resulted from using this function is that requirements for pregnancy during the last week are higher than those for the production of 6 kg of milk/day. The type of function and the low efficiency of energy utilization for pregnancy purposes are the explanation for this. The function is behaving as expected and I believe would be verified as correct if it could ever be measured. Any way it is during a very short period of time and it does not represent a large amount, particularly if it is considered relative to the total requirements.

Requirements for change of weight are established following the NRC formulas. Maintenance was divided in two portions as was explained earlier: vital activity which represents 63% of the total usually recommended as maintenance and a portion which is considered to be the true maintenance for any given live weight represents the remaining 37%.

With all these elements in the herd structure submodel it is possible to compute the requirements of the herd throughout the years given a fixed set of parameters. The distribution of requirements will depend on decisions of management such as selling policy of calves at weaning, heifers, dry cows and old cows. By changing these type of decisions, requirements of the herd could be influenced or changed so that maximal amount of beef (or $) is produced from the

nutrients available is achieved. Nutrient requirements will depend on rate of growth of young individuals and change of weight of the adults. An equation to describe rate of growth of different genotypes was derived; it is a function of age, mature weight and degree of heterosis. Hybrid vigor is maximum around weaning and minimum as maturity is approached. Since rate of growth depends also on growth during preceding periods, adjustment for this factor should be necessary in the future.

Production of Nutrients

A submodel on forage production will take into consideration the production of nutrients since the model was developed to include beef production under grazing systems. The forage production must be an integral part of the model because its production and quality is a function of the amount and pattern of grazing; i.e., beef production and forage production are interdependent, interacting variables. Dr. A.J. Dye of the Range Science Department at Texas A&M University will be responsible for this portion of the model. It will describe the amount and quality of forage available through the year based on rainfall, temperature, daylight, etc. Rainfall and probably temperature will be determined by a stochastic approach.

Other nutrients supplements to forage could be utilized and taken into consideration whenever they are available.

Reproductive Performance

A model that predicts reproductive performance of females has been developed recently (Sanders, 1974). The model could be used to predict the expected values for some of the rates utilized in the herd structure submodel. This model uses as inputs variables

such as: actual and expected weights and gains of females, age, lactational status, time after parturition, etc. Most of the inputs for this model are given by the herd structure and nutritional submodels. The outputs are the probabilities of estrus and pregnancy; that is, the information needed in order to establish the herd dynamics. Therefore, in the future, it might be possible to use this model of reproductive performance as a portion of the overall model.

Application of Decision Analysis with the Model

The model was developed with the help of the Texas A&M Bio-engineering Group of which Dr. D.W. DeMichele is the leader. This group was responsible for the decision of the language to be used and the programming of the model. Mr. Joseph B. Humber, graduate assistant, did the programming part on DYNAMO and he will use the model in order to optimize profit following decision analysis techniques and probably other methods utilized in the field of Operational Research.

Uses of the Model in the Future

In order to be completed the model should have a portion that will evaluate different alternatives and maximize or minimize different objective functions subject to a given set of constraints.

The work done at Texas A&M University is part of a project to increase competence in livestock development programs in the tropics. The project involves three other U.S. institutions working in the fields of Economics, Extension and Sociology, Forage and Nutrition and Diseases (this also at Texas A&M). The overall project is financed through an AID (section 211d) grant to each of these institutions. When a particular situation is undertaken, in the future,

each of these fields will impose restrictions or will fix goals that should be taken into consideration by the model and therefore work out the way, or to establish the system that will assure that restrictions are not violated and that the goals are met. Techniques such as linear programming, dynamic programming or others might be useful for that purpose.

The model could be useful to evaluate different breeding alternatives or combinations of genotypes. Comparisons of genotypes can be made with different systems of production such as cow-calf operation or a fattening operation or any combination of these two.

Portions of the model, the herd structure submodel for instance, could be useful for animal breeding studies. Possibilities of selection based on different levels of reproductive performance and replacement policies and feasibility of crossbreeding programs in a self contained system are examples to which the submodel could be applied.

In order to have the model working it was necessary to make assumptions that simplified the problem. However, as such assumptions are reviewed, it will become obvious that further research is needed in many of the fields which the model is intended to be covering. This is particularly true whenever we try to explain some of the relationships used on the model; some of them are based on empirical functions rather than on known biological explanations and certainly these are fields for future research. Model building is a synthesis type process and as such those who are associated with this step by step process probably are the ones who gain the most; this gain is in knowledge and a better understanding, within and across disciplines, of the overall problem.

Literature Cited

Agricultural Research Council. 1965. The Nutrient Requirements of Farm Livestock. N°2 Ruminants ARC. London.

National Research Council. 1963. Nutrient requirements of beef cattle. National Academy of Sciences. Pub. 1137.

Rattray, P.V., W.N. Garrett, N.E. East and N. Hinman. 1974. Efficiency of utilization of metabolizable energy during pregnancy and the energy requirements for pregnancy in sheep. J. Animal Sci. 38:383-393.

Sanders, J.O. 1974. A Model of Reproductive Performance in the Bovine Female. M.S. Thesis. Texas A&M Univ., College Station, Texas.

APPENDIX II

J. Mallory Davis Itinery In Guyana And Brazil

Date	Location	Approx. number* cattle surveyed	Visits and/or Activities involved
March 25-26	Paragominas, Brazil	-	Rainforest clearing for Pasture
27-30	Belem, Brazil	40,000	Slaughterhouse Data
31	Imperatriz, Brazil	-	Recently-established Ranches
April 1-2	Travel to Sau Paulo	-	-
3-11	Sau Paulo	500	Ranches, Research Organizations
12	Travel to Dourados	-	-
13-13	Dourados Area	1,500	Ranches
17	Travel to Rancharia	-	Ranches
18	Rancharia	6,500	Ranches
19	Travel to Aracatuba	-	Ranches
20	Aracatuba Area	8,000	Ranches
21	Travel to Sau Paulo	-	-
22-23	Sau Paulo	-	Cattle Show, Library
24	Uberaba	-	Experiment Station
25	Agua Azul	12,000	Rainforest Cattle Introductions
26	Estreito	-	-
27	Ligacao	8,000	Ranches
28	Belem	-	Ranch Manager
29	Paramaribo, Sarinam	-	En Route Guyana
April 30-May 2	Georgetown, Guyana	-	USAID, Min. Of Agriculture
May 3-5	Ebini	-	Experiment Station
6-7	Georgetown	150	Small Producers
8	Matthews Ridge	200	Experiment Station
9	Kabawer	200	Ranch
10-13	Rupununi District	2,000	Producers
14-15	Georgetown	-	World Bank, Bookers
16	U.S.A.		

*There is a wide range in accuracy and detail in the data obtained.

Production data and other information pertinent to the validation and subsequent usage of the beef production models to evaluate alternative management systems was collected in Brazil and Guyana from March 25, 1974 to May 15, 1974 by Mallory Davis. The data obtained are currently being copied on computer cards.

TO: Mr. Bernard W. Carter, Chief Agricultural Officer, and
Dr. Peter Fernandes, Principal Agricultural Officer, Veterinary and Livestock Science (also 211-d Coordinator and Counterpart)
Guyana Ministry of National Development and Agriculture

SUBJECT: Summary of Activities and Comments on Visit to Guyana between April 30th and May 15th, 1974

FROM: John Mallory Davis, Animal Science Dept., Texas A&M University

APRIL 30, 1974

(1) I arrived at Timheri Airport at about 10:30 on the ALM flight from Paramaribo.
(2) I checked in at the Grille Guest House and tried, unsuccessfully, to exchange cruzeiros for Gyanese dollars.
(3) I phoned Dr. Fernandes, who drove by and took me to see the newly-arrived Holstein heifers. We discussed the Moser project and compared figures and information on clearing costs and methods in North Brazil and Matthews Ridge. We discussed my in-country itinerary and scheduling, and came to an understanding that the main objectives of my visit were:

(a) for me to obtain a first-hand knowledge of present cattle production and management systems in the Ebini, Matthew Ridge, Rupununi and Coastal areas including an appreciation of the problems, limitations, levels of productivity, etc.

(b) for me to collect some specific production information from various cattle operations, existing libraries and informed individuals, but leaving the dissemination of questionnaires and the bulk of information gathering to be obtained via the Tuskeegee survey.

(4) I phoned Mr. Eason and found he was out of the country, along with a number of people I had hoped to see, including Mr. Ritsen, Dr. McKenzie and Mr. Edwards. Mrs. Eason invited me to come out to her house May 1st, which I was supposed to find out was a national holiday.
(5) Dr. Fernandes took me to a family gathering bar-b-que then brought me back to the guest house. We discussed the itinerary of visits to various locations and lined up the trip to Ebini for May 2nd, to coincide with Mr. Noel Holder's planned trip back to the station.

MAY 1, 1974

(1) All Georgetown businesses and offices were closed and I spent most of the morning reading consortium correspondence and reports, then saw the laborers' parades and walked around town.
(2) Mr. Abdool, driver from the Park Hotel, came by to see if he might take me to the Eason home that afternoon. I went with him at 1400. Mrs. Eason invited me to stay in their guest room, and I accepted the invitation for the time I was to be in Georgetown after the Ebini trip.
(3) We ate supper at Mrs. Eason's.
(4) Dr. Fernandes called to advise that Mr. Holder would pick me up between 0900 and 1000 May 2nd, and that I might return to Georgetown May 4th in a plane which had a scheduled trip that way.

MAY 2, 1974

(1) I checked out of the Grille Guest House, made reservations Georgetown-Miami for May 14th, then walked to the USIS (Kennedy) library but could not get in as the library hours start at 1000. I walked through the big market at the end of East Street and priced meat, then got one of my boots temporarily repaired by a friendly cobbler.
(2) Mr. Holder picked me up at 0930. Also making the trip were Mrs. Holder and son; the Ebini clerk, Mr. Buschell; a government employee going for a visit; and a corn project extention man, Mr. Messiah. We arrived at Ebini about 1530, after a stop in Linden, then a lot of sandy woods and savannahs and crossing the Berbice River.
(3) We settled in the guest house and ate a late dinner then walked around the station Later I looked through a number of reports and publications. I found most of the information of interest to us in two reports, copies of which Mr. Holder said I might have. All data generated in the livestock sector at Ebini over the past several years is on computer cards and tape at the University of Florida and might be obtained through Dr. Koger.
(4) Mr. Holder and I discussed the three-month breeding system, the pastures in use, the stress being caused by the present severe dry season, and the lack of emphasis at Ebini on producing slaughter animals of acceptable size. We went over my questionnaire and Mr. Holder had me over to his house in the evening.

MAY 3, 1974

(1) Mr. Holder took me to the Berbice, then showed me the cattle and pastures around the station.
(2) I read Dr. Harricharan's dissertation.
(3) Dr. Fred Marti of USAID and Dr. Hittle flew in about noon. I tried to catch a ride back to Georgetown with them but there was no room. A Guyana Defense Force plane was expected in on which I might hitch a ride, but it never came.
(4) I red most of the "Ebini Livestock Research Station Summary of Research Activities."

MAY 4, 1974

(1) Mr. Holder took me to see the Ebini bulls, then a dairy herd being started. After that we looked at the cattle on savannah pastures with and without legumes.
(2) I saw and chased down a big anteater to photograph it.
(3) I read most of the 1973 Ebini Annual Report.
(4) The Reynolds Co. plane picked me up about 1445. Two people were let off at Everton (the air strip at Rose Hall). The day was beautiful and most of the flight was made at 2500 feet, so I got a good look at the intermediate savannahs along the Berbice, then the sugar cane, rice, coconuts and cattle along the coast up to Georgetown.
(5) Dr. Fernandes had someone pick me up at Ogle air strip and leave me at the Eason residence.
(6) I paid Mrs. Cambridge for the meals at Ebini and verified with Mr. Buschell, the station clerk, that there were no other expenses to pay.

MAY 5, 1974 (Sunday)

(1) I went to see Dr. Marti but he was not in.
(2) I spent most of the rest of the morning at Mr. Milton Low's house, where Dr. Fernandes and I were able to plan the itinerary for the remainder of my visit in Guyana.

(3) Dr. Fernandes suggested I try to see Mr. Phillips (in Mr. Ritsen's place while he is away), Mr. Tiam-Fook of the Rupununi Development Company and Mr. Wilkins of Bookers. He also gave me names of ranchers I might visit in the Rupununi.
(4) Dr. Fernandes told me that the Guyana visit report need only be a travel log and could be turned in to him Monday, May 13th when he arrived in Lethem. (I planned to leave Lethem for Georgetown on the same plane he came out on, and return to the States shortly thereafter.)
(5) Dr. Howze arrived at the Park Hotel
(6) I read "The Taste of New Wine" by Keith Miller during the afternoon and evening.

MAY 6, 1974

(1) I went to the USAID office with Dr. Marti and saw Dr. Hittle.
(2) I saw Dr. Howze and got a copy of his survey questionnaire and indicated the hope that several questions of interest to us might be included.
(3) I tried at the banks, Brazilian airlines and Brazilian consulate to exchange cruzerios for Guyanese dollars but did not manage to do it.
(4) Dr. Fernandes, Mr. Browman, Dr. Howze, Dr. Marti and I met at the Ministry of Agriculture and went over both questionnaires and discussed plans for Tuskegee-organized survey. It was agreed that Dr. Howze and I would get together on the incorporating of questions of interest to the Texas A&M group into the survey, that Dr. Fernandes and Mr. Browman would study the questionnaire further and possibly suggest additions or changes, and that Dr. Howze and Mr. Browman would get together later to approve the final version.
(5) Dr. Fernandes gave me the 1972 and 1973 Ebini Annual Reports.
(6) I phoned Dr. Cartwright collect and talked to him from the USAID building.
(7) Dr. Hittle told me he would have room for me on a chartered flight to Matthew Ridge on Wednesday, May 8th. (I planned to flyout May 7th and come back to Georgetown May 8th, but could not get commercial airline reservations for May 7th).
(8) I discussed with Dr. Howze the inclusion of questions of interest to us in the Tuskeegee survey.
(9) I spent most of the afternoon in the USAID Memory Bank reading and obtaining photostatic copies.
(10) I met Mr. Phillips for an interview at 1530 to obtain some orientation and information for the Rupununi trip. Mr. Phillips has some raw weight data which we could use.
(11) Mr. Ralph May arrived about 2200. Mr. Wilkins was out of town during the day.

MAY 7, 1974

(1) I went to the USAID office with Mr. Marti at 0730.
(2) I went to the Park Hotel and saw Mr. May and Dr. Howze. We briefly discussed the questionnaire for the Tuskeegee survey.
(3) Mr. May and I went to the USAID Memory Bank.
(4) Mr. May and I bought Guyana Airways tickets scheduled to go to Lehtem May 10th and to return May 13th.
(5) Mr. May and I went to the Rupununi Development Co. and Meat Marketing Ltda. office where we saw Mr. Tiam-Fock and Dr. Frazier and obtained information on the Pirara and Dadenawa operations. A visit to Dadenawa was tentatively set for May 12th. We were shown company records of cattle shipments and abattoir weight data which we may come back to copy. Dr. Frazier indicated other people to contact and set up an appointment for me with Dr. Fulton.
(6) Mr. May and I went to the C & F Meat Centre where we saw Mr. Peter Frazier and his father. I copied some records of beef shipments from the family-

owned farm at Bushy Park and arranged to obtain others.
(7) I discussed again the incorporation of our questions into the Tuskegee survey with Dr. Howze. He agreed to put them in.
(8) I tried to get Pan American reservations to return to the States, but there is currently no logical way to fly to Miami or New Orleans from this area on Pan Am. I requested reservations with KLM for May 15th.
(9) Mr. May and I went to the Ministry of Agriculture, then over to see Dr. Fernandes. Dr. Fernandes made arrangements to have my visa extended; he gave me Georgetown abattoir veterinary reports to copy and arranged delivery of other abattoir records; he gave me a copy of the Summary of Ebini Research Activities. I checked my Matthews Ridge, Kabawer Ranch and Rupununi travel plans with Dr. Fernandes as well as my planned departure date of May 15th. I reconfirmed plans to submit my travel report to him on May 13th in Lethem since I would not be seeing him again after that before leaving Guyana. Any addendum to this report may be given to Dr. Romudet before my departure.
(10) Mr. May and I went to Mr. Sookraj's office and he gave me the abattoir records. We took these to Dr. Marti at USAID where they were copied.
(11) I went to the Park Hotel and copied the veterinary abattoir reports by hand.
(12) Mr. Abdool drove me to see Dr. Fulton for an informative interview dealing with the Rupununi Development Company.
(13) Mr. May and I got together after supper to coordinate our plans for the balance of the week, and I obtained the questions he wanted answered at Matthews Ridge.

MAY 8, 1974

(1) I flew to Matthews Ridge with Dr. Marti, Dr. Hittle, Mr. Adams and Mr. Fletcher. We arrived about 0845. The weather was good going and coming, which gave us opportunity for a good look at the country.
(2) Mr. Amsterdam and Mr. Smith met me and gave me a very thorough tour of the livestock sector, showing me the pastures and nearly all the cattle (at both ranch locations). We then spent over two hours going over the cattle records in the station office. Mr. Amsterdam let me take the herd books and other papers to copy and return via Dr. Fernandes.
(3) After a quick lunch we flew to the old port for the manganese mine and saw various agricultural projects there.
(4) We returned to Georgetown, arriving about 1730.

MAY 9, 1974

(1) Dr. Marti, Mr. May and I left Georgetown about 0700 in a hired car and drove to Bushy Park where we saw Mr. Jeff Frazier and his wife. Mr. Frazier gave me his cattle records to copy and return to him.
(2) We stopped to take a number of pictures and talked to a cattle buyer and a small farmer.
(3) We arrived at Bookers' Estates about 1030, where we met Mr. Dhaniram, the new manager of Kabawer and continuing old manager of Golddigging. The visit had been arranged the night before with Mr. Wilkins.
(4) Mr. Dhaniram took us in his land rover to see the cattle and records at Golddigging and suggested that we get copies from Mr. Wilkins in Georgetown. He then took us on to Kabawer and all the way to Abary Creek.
(5) We got back to Georgetown at 1700 and Mr. May and I went by to see Dr. Fernandes. Dr. Fernandes gave us letters authorizing visits to Rupununi ranches and Ameridian villages. I gave him my ticket which he was to have rewritten for leaving on KLM on May 15th for the States. We discussed briefly my impressions regarding the work and potential for cattle production in the Ebini

and Matthews Ridge areas.

MAY 10, 1974

(1) Mr. May and I left for Timheri airport about 0630 and arrived at Lethem around 1030, where Dr. Applewhaite met us. We discussed our proposed itinerary for our three-day stay in the Rupununi.
(2) I went by the Lethem abattoir and spoke briefly with the superintendant, Mr. Dorn. An appointment for going over the abattoir records was made for May 13th.
(3) I exchanged 600 cruzeiros for 200 Guyanese dollars with Mr. Lomas.
(4) Dr. Applewhaite settled us in the guest house and, after dinner, Dr. Applewhaite, Mr. May, Mr. Doi the driver, and I drove north about 80 miles up past Good Hope. We spent several hours visiting the largest Brazilian ranch in the area, Fazenda Guanabara, and talking with the owner, Dr. Newton Tavares. He keeps excellent records and is anxious that Dr. Tom Craig visit his place while in this area since he has a critical disease problem which, once the symptoms appear, inevitably results in the death of the animal. Only fat cattle, in apparently good condition, are affected. He said he would gladly sacrifice any animal that Dr. Craig wished.
(5) We took pictures of good-looking cattle along the Takatu River (Mr. Gurenski's), and visited a foot-and-mouth check point on the river.
(6) We arrived back in Lethem about 2000.

MAY 11, 1974

(1) Mr. May and I left Lethem about 0800 with Mr. Ranjen, the driver, and drove north to Pirara ranch where we met the manager, Mr. Fung-On. He showed us some of the cattle, then he took me to another foot-and-mouth check point on the River opposite Gomes.
(2) We went by Buritizeiro and took some pictures.
(3) Next we went to Cajueira, where we met Mr. Michael McTurk and saw some of his cattle.
(4) After that we made visits to the following Amerindian villages, where we talked to the respective "Tushaws" and obtained what information we could about their cattle: Toka (next to the mountains), Yupacari (the more wooded area), Quotata, and Maracanaba.
(5) We returned to Lethem about 1900 via the Manari outstation.

May 12, 1974 (Sunday)
(1) Mr. May and I left Lethem about 0800 with Mr. Ranjen, the driver, and drove south to Dadenawn Ranch, where we were met by Mr. and Mrs. Humphreys, Mr. Chan, Mr. Simpson and Mr. Fredricks. I spent the remainder of the morning and part of the afternoon obtaining production information from Mr. Fredricks. After a larger dinner than necessary we were taken further south to see some cattle at the Araquai outstation.
(2) We left Dadenawa about 1530 and went to the Amerindian village of Sand Creek and obtained some information from the Tushaw there.
(3) We went by Santa Cruz to see Mr. Nash Anderson but he was not in; we also went by Wichabai and saw the abandoned old home of John Melville.
(4) We got back to Lethem about 1900.

NOTES ANS COMMENTS

(1) Activities planned for May 13th and 14th, after returning to Georgetowm from Lethem on the morning of the 13th, include the following: see Mr. Ritsen who should now be back; see Mr. Tiam-Fook; see Mr. Wilkins; see Mr. Williams, secretary of the Livestock Development Company; see Mr. Peter Frazier; see Dr. Frazier. If project-related activities other than those interviews are engaged in, I will summarize them in an addendum to this report, to be delivered to Dr. Romudet.

(2) Preliminary impressions relating to beef cattle production formed on this trip"

(a) I feel the more promising work at Ebini are the investigations into the usage of savannah lands with minimal alteration. Perhaps a commerciably feasibly cow-calf operation could be had by utilizing range for dry cows and during parts of the lactation period for the cows with calves. Formed pastures, preferably located on the scattered areas of better soil (especially the riverside forests, where fertilization would be less critical), would be used for fatterning and suring periods of stress.

(b) I believe there is a real future for beef cattle in areas similar to that at Matthews Ridge. Perhaps more economical clearing and better pasture formation would result from a single burning and seeding (or spriging) the land without packing and disturbing the topsoil with heavy equipment.

(c) It seems that the stocking rate on many parts of the Rupununi could be much increased. Once all-weather overlandtransportation facilities are available to this area, I believe a rapid intensification in cattle and crop production can be expected.

John Mallory Davis, May 13, 1974

TO: Mr. Bernard W. Carter, Chief Agricultural Officer, and Dr. Peter Fernandes, Principal Agricultural Officer, Veterinary and Livestock Science (also 211(d) Coordinator and Counterpart)
Guyana Ministry of National Development and Agriculture

SUBJECT: Addendum to Summary of Activities and Comments on Visit to Guyana between April 30th, 1974 and May 15th, 1974

FROM: John Mallory Davis, Animal Science Department, Texas A&M University

May 13, 1974

(1) Mr. May and I visited the Lethem Abattoir, where Mr. Dorn presented us with the abattoir records. We also talked with Mr. Jones, who gave us an entertaining account of some of the history of the area.
(2) We paid Dr. Applewhaite for the gasoline and driver provided us during our stay in the Rupununi. We also paid Mrs. Matthews for the excellent meals she served us.
(3) We spoke briefly with Dr. Fernandes, Dr. Frazier and Dr. Howze at Lethem before boarding the plane and returning to Georgetown, via Annai. I gave Dr. Fernandes my Guyana trip report.
(4) Mr. May and I went to see Mr. Ritsen and obtained some information and projections for various locations in the Rupununi and in the coast.
(5) Mr. May and I went to see Mr. Wilkins and had a long, informative discussion with him regarding Kabawer Ranch-its past, the present, and future plans.
(6) Mr. May and I had supper with Dr. Jim Simpsom, former manager of the Rupununi development Company, at the Georgetown Club.

May 14, 1974

(1) Mr. May and I visited with Dr. Marti, and I gave copies of my Guyana trip report to him and to Mrs. Eason for delivery to her husband in Florida.
(2) I exchanged my Guyanese dollars for U.S. currency and confirmed my reservation on KLM flight 945 leaving Timheiri airport at 1050 on May 15th for Miami.
(3) Dr. Marti, Mr. May and I visited the C&F Meat Centre, where I obtained meat retail prices and returned cow data cards from Bushy Park to Mr. Frazier.
(4) Dr. Marti, Mr. May and I visited the Municipal Abattoir where I obtained photographs of the enterprise in operation.
(5) Dr. Marti and I visited Mr. Phillips in the Livestock Project Division of the World Bank and picked up some information Mr. Ritsen had promised us.
(6) Dr. Marti, Mr. May and I visited Mr. Tiam-Fook and Mr. Simpson at the Rupununi Development Company and Meat Marketing Ltda office on America Street.

NOTES AND COMMENTS

(1) I enjoyed this trip to Guyana and am already looking forward to my next visit. I would like to personally thank all the people in the various parts of Guyana with whom I have had contact. Each person, without exception, has been helpful and courteous, and has shown a gratifying interest in our work. Not being able to thank each individually, I must single out a few who have done much to make this a very successful trip for me: Dr. Peter Fernandes, Mrs. Gene Eason, Mr. Noel Holder. Dr. Fred Marti, Mr. Ronald Amsterdam, Mr. Smith, the Frazier Family, Mr. Ralph May, Mr. and Mrs Humphreys, Mr. Joe Ritsen, Mr. Ray Wilkins, Mr. Tiam-Fook, Dr. Applewhaite, Mr. Ranjen, Mr. Fung-On, Mrs. Cambridge, Mrs. Matthews, Mr. Michael McTurk, the Tushaws at the various Amerindian villages, Mr. Jeff Lomas, Mr. Jim Simpson, Dr. Frazier, Dr. Fulton, Mr. Bazell Phillips, Mr. Dhaniram, Miss Jewel Sloate, Mr. Johnny Fredricks, Mr. Milton Low, Mr. John Brownman, Mr. and Mrs. Mancini, Dr. Hittle and Dr. Romudit.

John Mallory Davis, May 14, 1974

APPENDIX III

OUTLINE FOR SYLLABUS

BEEF PRODUCTION IN THE TROPICS

Introduction

1. The Tropical Enviornment
   - A. Geography
     1. Latitude and longitude
     2. Land area
     3. Altitude
   - B. Climate
     1. Humid tropics
        - a. Equatorial
        - b. Monsoon
        - c. Trade wind
     2. Dry tropics
        - a. Arid
        - b. Semi-arid
   - C. Soils
     1. Humid tropics
     2. Dry tropics
   - D. Vegetation
     1. Humid tropics
     2. Dry tropics

II. The Tropical Countries
   1. Principal cattle producing countries
   2. Human-animal unit ratio
   3. Human diet-animal protein level
   4. Present and potential cattle production

III. Cattle in the Tropics
   1. Types and breeds
   2. Numbers and distribution
   3. Systems of production
   4. Land per animal unit
   5. Levels of production

IV. Major Obstacles to Beef Production in the Tropics
   1. Environmental stress
   2. Parasites and diseases
   3. Poor Communication, roads, transportation
   4. Marketing facilities and practices
   5. Lack of refrigeration
   6. Poor management
   7. Unimproved breeding stock
   8. Socio-economic problems and traditions

V. Animal response to high ambient temperature.
   A. Climate
      1. High temperature (thermal stress)
   B. Physiology if heat regulation
      1. Heat exchange (homeotherms)
      2. Heat production
      3. Heat loss
   C. Anatomical characteristics and their contributions to heat regulation
VI. Effects of thermal stress on performance
   A. Appetite
   B. Efficiency of feed utilization
   C. Growth
   D. Reproduction
   E. Milk production
VII. Tropical forages
   A. Importance
      1. Nature
      2. Distribution
   B. Problems of tropical pastures
      1. Climate
      2. Soils
      3. Biotic factors
   C. Nutritive Value
      1. Chemical composition
      2. Digestibility
      3. Animal performance
   D. Pasture improvement
      1. Plant introductions
      2. Improved grasses
      3. Culture
      4. Management
   E. Tropical legumes
      1. Need
      2. Contribution
      3. Adapted species
   F. Economics of tropical grasslands
VIII. Systems of cattle production in the tropics
   A. Asia
      1. South
      2. South-east
   B. Africa
   C. Australia
   D. Latin America

IX. Improvement of cattle performance
- A. Management
  - 1. Nutrition
  - 2. Selection and culling
  - 3. Reduce losses from disease and parasites
  - 4. Improved husbandry practices
- B. Breeding
  - 1. Use of adapted breeds and crosses
  - 2. Use of indigenous disease and parasite resistant breeds
  - 3. Use of environmentally adapted exotic breeds for crossing and upgrading
  - 4. Performance and progeny testing of breeds and crossbreeds for superior genotypes in a given environmental complex
  - 5. Development of new breeds

X. Animal Health
- A. Diseases
- B. Parasites

XI. General considerations
- A. Marketing of beef and beef byproducts
- B. Other sources of meat-buffalo, goats, camel, wild animals
- C. Credit
- D. Agratian reform
- E. Education
  - 1. Research
  - 2. Extension

APPENDIX IV

ANIMAL SCIENCE DEPARTMENT

ANIMAL BREEDING AND GENETICS SEMINAR

ON

TROPICAL BEEF PRODUCTION

CROSSBREEDING IN TROPICAL VENEZUELA AND BOLIVIA

3:30 p.m. Monday

July 2, 1973

Room 203 Animal Industries Bldg.

by

Dr. Dieter Plasse

Professor, Veterinary Science Faculty

(Leader, Genetics Group)

Central University of Venezuela

Maracay, Venezuela

Dr. Plasse did his undergraduate and masters work at the Animal Breeding Institute, University of Gottingen under Prof. Fritz Haring. He then worked toward his Ph.D. degree doing his research with Prof. Marvin Koger at the University of Florida. Dr. Plasse has been very active in Venezuela in organizing and carrying out beef cattle breeding research. Most people in animal science are familiar with the fact that he has numerous publications in English and Spanish.

Dr. Plasse has made an enviable record of accomplishment in Venezuela in a relatively short time establishing a reputation as a scientist. At the same time he has gained the reputation for being practical and developing information and recommendations immediately applicable.

ANIMAL SCIENCE DEPARTMENT

SEMINAR

Animal Breeding and Genetics Section
12:00 Noon
Friday, September 14, 1973
Room 203 AI Building

"A DYNAMIC BEEF CATTLE HERD MODEL"
by
Joe Humber and Guillermo E. Joandet

Population geneticists have long recognized that a population has genetic characteristics which can not be imputed from the separate characteristics of the individual members of the population. However, they have not generally recognized the corollary that population (or herd) production characteristics can not be inferred from the characteristics of its isolated members. One reason for this failure certainly must have been the imposing nature of the task of accounting for all the interacting components affecting production particularly as it relates to efficiency. The techniques of operations research and the capacity of electronic computers have now made it feasible to model herd production. Joe Humber has brought expertise in operations research and "Willy" Joandet has directed the constructing of a beef herd model which they will describe.

Those in nutrition, physiology, beef production, and economics, will be as interested as those in genetics in learning about the values and methods used in constructing the model. Perhaps those in Extension will have even more interest in its potential use for formulating realistic recommendations.

ANIMAL SCIENCE DEPARTMENT

SEMINAR

ANIMAL BREEDING AND GENETICS SECTION

12:00 Noon

Friday, October 5, 1973

Room 203 AI Building

"THE RELATIONSHIP BETWEEN SIZE AND PRODUCTION EFFICIENCY OF AFRICANDER CATTLE IN RHODESIA"

by

Dr. Johan Steenkamp

Dr. Steenkamp is Principal Research Officer at the Matapos Research Station, Bulawayo, Rhodesia. At present he is spending 4 months leave as Research Scientist consulting with the Tropical Beef Production project of the Animal Science Department. In addition to consulting, Dr. Steenkamp has brought along data he has collected over a number of years on Africander cattle supplemented at different nutritional levels. These data will be further analyzed here and used to validation test of a system production model. Dr. Steenkamp has collected a wealth of data under closely controlled conditions which will add to our knowledge of methods to increase production efficiency. One question for which these data are useful in answering is that of the effect cow size on production efficiency.

ANIMAL SCIENCE DEPARTMENT

SEMINAR

ANIMAL BREEDING AND GENETICS SECTION

12:00 Noon

Friday, December 14, 1973

Room 203 AI Building

"CURRENT RESEARCH IN CATTLE BREEDING IN IRELAND"

by

Dr. E.P. Cunningham

Many of you are familiar with Dr. Cunningham's publications. All animal breeding major's are familiar with his book Animal Breeding Theory published in 1969. Dr. Cunningham is with The Agricultural Institute, Animal Production Research Centre, Dublin.

In addition to an overview, he will speak more specifically to the topic of "cost effectiveness" of beef and dairy production - a topic which will especially appeal to those in production and to the modelers.

ANIMAL SCIENCE DEPARTMENT

SEMINAR

ANIMAL BREEDING AND GENETICS SECTION

12:00 Noon

Friday, February 22, 1974

Room 203 AI Building

"BEEF PRODUCTION IN COLOMBIA"

by

Fernando Gomez

A description of the existing situation in Colombia regarding beef production and potentials for change as well as action being taken to bring about these changes. The role of research in this activity will be discussed.

NOTICE OF A SPECIAL SEMINAR
TO BE PRESENTED
BY

DR. R. W. (DICK) RICE
DEPARTMENT OF ANIMAL SCIENCE
UNIVERSITY OF WYOMING

SUBJECT MATTER:

SIMULATION OF ANIMAL FUNCTIONS
IN MODELS OF PRODUCTION SYSTEMS:
RUMINANTS ON THE RANGE

TIME: JULY 1, 1974 - 3:00 PM
LOCATION: ROOM 118, TEAGUE RESEARCH CENTER

ALL INTERESTED FACULTY AND STUDENTS
ARE URGED TO ATTEND!!

APPENDIX V

TEXAS A&M UNIVERSITY
COLLEGE OF AGRICULTURE
COLLEGE STATION, TEXAS 77843

Department of
ANIMAL SCIENCE
Instruction — Research — Extension

June 10, 1974

MEMORANDUM

TO: Dr. Carl Sierk, Dr. Lloyd Clyburn and other interested persons

FROM: J. Conrad, G.E. Cooper, T.K. White and T.C. Cartwright

SUBJECT: Range Seminar for Representatives of the Sahelian Countries to be Sponsored by USAID

One representatives from each of the institutions of the USAID 211(d) Livestock Consortium travelled to Mali, Upper Volta, Cameroon, and Chad to observe livestock production in the Sahel and to confer with governmental officials, producers and others in related activities. These 211(d) institutional representatives were accompanied by Mr. Rex Henry, Project Manager, Regional Livestock, USAID/Dakar, in Mali, and by Dr. Andre H. Robinet, Chief, Livestock and Fisheries Department, FAC, Paris, France, in the remaining countries. These advisors were indispensible to the accomplishment of the mission.

The following list is a summary of suggestions and observations made by those with whom the team conferred (see Appendix) concerning the seminar sponsored by USAID for representatives from Sahelian countries. Most of these points were stated by Africans, however, some are more interpretations of impressions gained during the course of many conferences. A few points were made by expatriots. Dr. Robinet has reviewed a draft of this memorandum and made very helpful suggestions. The items listed often overlap and are not ordered according to priority except as indicated. Some of the topics do not relate directly to the theme of range management and obviously all of them can not be presented. Some are technical or not of general interest and may be covered by individual conferences.

Several livestock officers requested that the seminar be held in September to be completed in early October, because of a livestock inventory scheduled in the Sahelian countries.

I. GENERAL

A. Theory and abstract concepts should be minimal. Emphasis should be on established, demonstratable practices.

B. The seminar should be designed and presented as a broadening experience (rather than to present practices for extrapolation) which will enhance the ability of participants to conceive ideas and formulate relevant plans.

C. The consensus of scientific opinion on "Keeping the desert alive". Is it possible? Is it worth it? What measures must be taken? Must people be sedentarized?

D. Middle and long term views for solving drought related problems in the U.S.

E. Position of research on the concepts of drought intervention. Can research assist in alleviating these problems?

F. The use of systems analyses to cope with optimizing output of the Sahel. The point became clear, one way or another, that the application of a systems approach was considered necessary; in general terms this point was appreciated by all the persons interviewed.

II. EXTENSION

A. Group reaction sessions should be included to discuss problems and solutions incurred during drought conditions as it may relate to program implementation and effect.

B. Extension service in action - a stepwise account of the method by which a recommended practice is implemented with observation of example. Include how the Extension Service responds to the needs of people (sensitivity to people) and how to induce (illiterate, ingrained nomadic) people to become modern (sedentary) producers.

III. OBSERVATIONS (Combined with talks)

A. At least one-half of the time should be devoted to "on the ground observations".

B. Range management, including water management and multiple species stocking. <u>First priority</u>.

C. Brush (undesirable woody species) control and eradication.

D. Livestock operations in semi-arid areas. One or two examples covered in depth are preferred. An Indian reservation and/or Bureau of Land Management operations were suggested. (Dr. Robinet cautioned about a possible reaction to Indian Reservations which would divert attention from the Seminar topic.)

E. Feedlot finishing operation including economic analysis.

F. Example of each step of livestock production followed through marketing at each step to the retail level and producer consumption.

G. Modern, medium size slaughter house.

IV. VETERINARY

A. Programs for control and eradication of disease (T.B., Brucellosis, Anaplasmosis, Piroplasmosis, etc.), and parasites (Internal parasite control, screw worm eradication program, and mosquito control).

V. ECONOMICS (Other than above)

A. Economic infrastructure - cooperatives, credit, banking, markets.

B. Marketing to increase value of product.

C. Stratification of the beef production system.

D. Land use and tenure

E. Capital and its use in cattle production - investment, rate of return, etc.

F. Economics of byproduct utilization.

G. Economic implications of livestock tax and trade policies.

VI. NUTRITION

A. Supplemental feeding of minerals and proteins.

B. Feeding byproduct feeds (feed value).

C. Nutrition and its influence on reproduction and longevity.

D. Native and introduced or improved grasses.

E. The use of forage analysis information in livestock feeding.

VII. BREEDING AND PRODUCTION SYSTEMS

A. Alternative uses of limited supplies of byproduct feeds; e.g., determining priorities for feeding calves vs. three year old males vs. four year olds vs. milk cows, etc.

B. Breeding systems.

C. Zebu in the U.S.; origin and development into breed(s).

VIII. MISCELLANEOUS

A. Remote sensing to aid in directing livestock movement.

B. The effect of cropping on land depletion.

List of Names and Addresses of People Visited
on 211d Ruminat Livestock Consortium Trip
to West Africa - May 18 to June 9, 1974

Participants:
Dr. T. C. Cartwright, Texas A & M University
Dr. Joe H. Conrad, University of Florida
Dr. George Cooper, Tuskegee Institute
Dr. T. Kelly White, Purdue University

Paris 5/19 - 5/20
Mr. Howard Helman, USAID/Paris, % American Embassy
Tel: Office 265-7460 Ext. 7225; Home 224-0688
Office Dv. André H. Robinet, Chief (Tel. SUF 79-70 Ext. 147
Livestock and Fisheries Dept. SUF 46-71 Ext. 147
French Ministry of Foreign Affairs
20 Rue Monsieur, 75007 Paris

Home 8 Rue Foury, 92310 Sevres, France
Tel 027-5356

Bamako, Mali 5/21 - 5/28
Mr. Rex Henry, Project Manager, Regional Livestock,
USAID/Dakar

Dr. Alassane Diaoure, Chief Veterinary and Animal Industry Officer
Dr. Bobacar Sy, Head Meat Marketing Board
Dr. N'Galo Traore, Head Economics Institute

Niono, Mali 5/22
Livestock Experiment Station
Dr. Taoure, Sector Veterinarian
Dr. Magi, Veterinarian in Charge of Experiment Station

Nara, Mali 5/24
Livestock Station
Dr. Tall, Sector Veterinarian

Sotuba Experiment Station near Bamako 5/27
Dr. Samba, Veterinarian in Charge of Experiment Station

Ouagadougou, Upper Volta 5/28 - 5/31
Mr. Donald L. Atwell, AID Representative for Drought Programs
USAID/Ouagadougou
Mr. Mark Johnson - Consul/American Embassy
Dr. Nakure, Minister of Agriculture (Met at Dori)
Dr. Coulibaly, Director of Veterinary and Livestock Services
(Met us at Markoy and Dori - 5/31)
Dr. Bere, Deputy Director
Dr. Tall, Executive Secretary Economic Commission
Met him at Hotel Independencia

Dr. Nicolas, French Veterinarian

Two French Veterinarians on MIT Contract surveying small ruminants at Gorom-Gorom

Abidjan, Ivory Coast 6/1
Dr. William H. Morris, Purdue/AID

Yaounde, Cameroon, 6/1 - 6/3
Mr. Lawrence A. Beery, Project Manager
General Agricultural Projects
USAID/Yaounde, Cameroon

Dr. Nicolas Eyidi
Ministere de l'Elevage
Directeur des Productions Animales
et de l' Animation Pastorale
B. P. 1050
Yaounde, Cameroon

Dr. Donald Ferguson, Agr. Economics
Southern University
Baton Rouge, Louisiana
AID Contract, Yaounde, Cameroon

WAKWA Experiment Station 6/4
Adamaoua Plateau
Dr. P. H. Lhoste, Director-Zootecnician
Dr. Enguelegule, Director of Extension
Dr. J. Pierson Veterinarian
Dr. G. Rippstein, Pasture and Forage (Agrostologist Swiss)

Institut d'Elevage et de
Medecine Veterinaire des pays Tropicaux
I.E.M.V.T.
Centre de Wakwa
Ngaoundéré, Cameroun

N'Djamena, Chad 5 June - 9 June
Ambassador Edward W. Mulcahy
Mr. Donald Hester, Vice Consul also AID
Monsieur Rene Guilbaud, Chief French AID Mission
Mission D'Aide et de Cooperation
N'Gardoum Djidingan, Minister of Agriculture (Didn't meet)
Dr. Mahamat Touade, Director of Livestock
Dr. Albert Mamadou, Director of Slaughterhouse and Cattle Export
Dr. Maeyer, Drought Coordinator at Ati

Lake Chad Basin Commission (5 June)
Commission du Basin du Lac TChad
Mr. Benson O. Tomo, Executive Secretary (Nigerian)
Dr. Renard, Chief of the Livestock Sector
Dr. Crouail, Director Assale - Serbewel Project
Dr. Vallat, Chief Assale Sector Project (Chad)
Mr. Scotty Deffendol, Chief Serbewel Project (Cameroon)

Dr. Jean Vandenbussche, (Feed Mill)
Directeur du Centre de Modernisation des
Productions Animales, Farcha

Farcha Laboratories 5 June

Dr. G. Tacher, Deputy Director (Directeur Adjoint)
Newly appointed deputy director of
International Livestock Center for Africa (ILCA)
at Addis Ababa, Ethiopia
Nokoury, DVM, Deputy Director
Monsieur A. Gaston, Agrostologist
Dr. J. Gruvel, Entomologist studying tsetse fly

Laboratoire de Recherches
Veterinaires et Zootechniques
de Farcha (or)
Laboratoire de Farcha
B.P. 433
N,Djamena, Tchad

Institut D'Elevage et de
Medecine Veterinaire
I.E.M.V.T.
10, Rue Pierre Curie
74700 Maisons-Alfort, France

Please note:

We have been advised by AID/Washington that the best way to communicate with AID Missions in Africa is to mail it to Dr. Carl Sierk with a note indicating who it is to be forwarded to. It will then be sent from Washington to the Embassy of that particular country.

Visit of 211d Tropical Ruminant Livestock
Consortium to N'djamena-Tchad June 4 to June 8, 1974

The team was composed of the following:

Dr. A. Robinet, Expert Consultant, Chief Livestock Officer, FAC, Paris.
Dr. T. C. Cartwright, Texas A & M University.
Dr. Joe H. Conrad, University of Florida.
Dr. George Cooper, Tuskegee Institute.
Dr. T. Kelly White, Purdue University.

The 211d Ruminant Livestock Consortium consists of representatives of seven disciplines in four U. S. Universities. These disciplines are (1) animal nutrition, (2) forage production, (3) veterinary medicine, (4) animal production, (5) extension, (6) sociology and (7) economics. The purpose of the Consortium is to integrate these seven disciplines within a systems analysis framework and develop expertise in analysis of livestock development problems in tropical regions through this integrated, multidiciplinary approach.

The purpose of this visit by representatives of the Consortium to Central West Africa is two fold. It provides an opportunity for consortium members to gain first hand knowledge of livestock production and marketing systems as they exist in this region. This knowledge will contribute significantly to the achievement of the consortium's overall objective. Knowledge gained through observation and interaction with individuals involved in all phases of livestock development will be used in preparing and presenting a seminar on livestock production systems in arid regions of the U. S. This seminar, to be held in September and October in Texas, is being sponsored and organized by AID Washington for representatives of Central West African Countries. The consortium will aid in planning and conducting the seminar. The consortium has not been informed of the procedure for selecting participants to attend the seminar.

The team arrived at N'Djaména on June 4, 1974 after having spent two weeks in Mali, Cameroun and Upper Volta. Mr. Donald Hester, U. S. Embassy, met the team and we are grateful for his support during our visit.

On Wednesday June 5, 1974, we went directly to Mr. Hester's office where plans were initiated for our visit to various Chadian agencies. Visits were also suggested to the Ranch of Ouadi Riémé, near Ati, and to various livestock production areas of interest in the Lake Chad Basin.

Visits made and people contacted during our visit are as follows:

<u>Wednesday, June 5, A.M.</u>

Mr. Donald Hester, U. S. Embassy.
Mr. René Guilbaud, Chief of French Aid Mission.

Dr. M. Touadé, Director of Animal Production, Chad Ministry of Livestock.
Dr. G. Tacher, Deputy Director, Laboratory of Farcha.
Dr. Maeyer, Drought Coordinator at Ati.
Dr. Nokoury, Deputy Director, Laboratory of Farcha.
Mr. A. Gaston, Agrostology.
Dr. W. Gruvel, Entomologist, Tsetse Program.

Wednesday, June 5, P. M.

Met with Lake Chad Basin Commission:
Dr. Renard, Sector Chief Livestock.
Dr. Crouail, Director, Project Assalé/Serbewel.
Mr. Scotty Deffendol, Sector Serbewel Chief.
Dr. Vallat, Sector Assalé Chief

Thursday, June 6

Dr. Jean Vandenbussche, Director Feed Manufacturing for Animal Production Center.
Cattle market at Massaguet where cattle are sold each Thursday to supply the N'Djamena domestic and export market.
Mr. Benson O. Tonwe, Executive Director, Lake Chad Basin Commission. We were cordially received in his office where he indicated that much progress had been made but the constraints to progress were:
1). personnel;
2) funds;
3) infrastructure;
4) sociological.

Friday, June 7, 1974

We visited Dr. Touadé's office briefly, then went to visit the slaughter house.

Mr. Mamadou is in charge of the Frigorifique de Farcha. We had an excellent discussion and he took us on a tour of the facilities. Facilities were opened in 1958 and slaughter reached 15,000 tons in 1972. Chilling facilities were indicated as the limiting constraint rather than supply of cattle or demand for beef.

Observations

1. The team's exposure to Chad's livestock sector was limited to discussions with various technical and administrative people in N'Djaména and a visit to the cattle market at Massaguet. Trips to Bol and Ati were planned but transportation could not be arranged.

2. The Farcha Laboratory has a strong basic research program, but there appears to be only very inadequate mechanisms for transforming basic research results into practical recommendations and extending them to livestock producers. The existing research program depends heavily on French scientists and financial support.

3. The Lake Chad Basin Commission is placing considerable emphasis on intensive finishing of cattle. There is some question as to the existence of adequate market infrastructure to support stratification of livestock

production. A careful analysis of the economics of using irrigated land for forage production in competition with alternative crops should be made.

4. The feed mill provided by USAID is operating at capacity using a combination of local and imported ingredients. The feed being produced is expensive and probably would not be an economical imput for livestock unless heavily subsidized.

5. The political situation in Chad appears to pose a barrier to modernization of the livestock industry.

APPENDIX VI

ABSTRACT

A Model of Reproductive Performance in the Bovine Female. (August, 1974)

James Olin Sanders, B.S. Texas A&M University

Chairman of Advisory Committee: Dr. T.C. Cartwright

A computer model was developed to simulate the occurrence of estrus and conception in cows and heifers during a specified time period, given genotype for growth and puberty characters, age, weight, rate of weight gain, time since calving, and lactational status. Minimum weight and minimum age at puberty, maturing rate, and condition constant weight at 8 months, 12 months, and maturity are specified for each genotype. The model recalculates weight, age, and time since calving for each 20 day period. Correction factors for weight, weight gain, time since calving, and degree of maturity were derived from data in the literature and are used in the equations for the probability of estrus and conception. Corrections were made for lactating vs. dry cows, but it was assumed that level of milk production does not affect fertility if differences in age, weight, and weight gain are considered.

The validity of the model was tested against data reported in the literature and against data on Angus-Jersey crossbred and Hereford cows collected at the Texas A&M

University Agricultural Research Center at McGregor from 1968 to 1971. In general, the simulated results were consistent with the actual data. The largest discrepancy between the simulated and actual results was with the Angus-Jersey crossbred data from McGregor. Apparently, an assumption of the model, that skeletal growth is unaffected by plane of nutrition, was violated in this case. The necessity of developing models that adequately describe the differential effects of nutrition upon growth of different tissues was discussed.

Fertility was simulated for yearling heifers and for two, three, and seven-year-old cows of the same genotype, but with different pre-breeding season weights and different rates of weight gain within each age class. Also, within each of these age classes, genotypes were simulated with different growth parameters; heifers of different genotypes were also simulated by varying parameters of the equation for the correction factor for degree of maturity. In the genotype simulations, initial weights and weight gains were the same within each age group.

For all simulated ages, increasing either daily gain or initial weight improves fertility, up to a point. Above this point, increases in either weight or weight gain are not predicted to affect fertility. Obviously, this

assumption would be violated in cattle whose fertility is adversely affected by obesity. Age at puberty is predicted to decrease when weight gain or initial weight is increased for all levels simulated in this study. However, at high planes of nutrition, the model will give a minimum age at puberty; increasing either weight or weight gain will not further decrease this age. Minimum weight at puberty is predicted to occur at moderate levels of nutrition. Either increasing or decreasing weight or weight gain from these moderate levels will increase the simulated weight at first estrus.

Rather large differences in fertility were predicted for the different simulated genotypes, when weight and weight gain were held constant. These differences imply that it is essential to correctly specify growth and puberty parameters if fertility is to be accurately simulated.

This model of cattle fertility is intended to be a component of a complete cattle production model that is being developed at Texas A&M University and is funded through an AID Section 211(d) grant.

INFORME DEL GRUPO DE TRABAJO DE REPRODUCCION Y GENETICA DEL SEMINARIO SOBRE AMERICA TROPICAL: POTENCIAL PARA AUMENTAR LA PRODUCCION DE CARNE. ORGANIZADO POR EL C.I.A.T. EN CALI, COLOMBIA DEL 18 AL 21 DE FEBRERO DE 1974.

Coordinador: Guillermo E. Joandet
Miembros: Gerardo Carneiro, Thomas C. Cartwright, Ernesto Huertas, Jean Pagot, Dieter Plasse y Hubard H. Stonaker.

Reproducción es probablemente el carácter simple de mayor importancia en la producción de carne del trópico. Los bajos porcentajes de parición, acompañados por alta mortandad y un crecimiento interrumpido en forma estacional hace que la producción de carne sea muy ineficiente en estas areas.

El aumento de la eficiencia se logrará si se estudian las técnicas o factores que pueden modificarla en forma aislada. Por ello es necesario contar con esquemas integrados que involucren todos los aspectos o disciplinas que deben intervenir para mejorar la situación. La interacción de efectos simples hace que la ventaja de cada uno de ellos sea multiplicativa, ademas de aditiva.

Es por esa razón que nuestra comisión al encarar el problema de la tasa reproductiva empleo un esquema integral a pesar de que solo se han de discutir los aspectos que conciernen a las ramas de reproducción y genética. El objeto de presentar este esquema es para tratar de que los esfuerzos de otras comisiones o ramas de la tecnología se integren para lograr un aumento en la producción de carne. A pesar que hemos tratado de mantenernos dentro del esquema seguramente habra superposiciones o repeticiones, pero ellas son preferibles a la omision de aspectos de importancia.

En la Figura 1 se muestra el esquema empleado como base de discusión general. La eficiencia reproductiva de un hato depende del comportamiento de las hembras y machos que lo componen. El comportamiento de cada uno de esos individuos a su vez, depende de una serie de variables cuya lista parcial se presenta en esta figura. Algunas de ellas estan asociadas o influyen sobre un sexo en particular y otras son comunes a ambos. De igual modo hay variables que cambian o se modifican a travez del tiempo y/o con la edad del animal. El objeto de esta figura es poder tener un equema general para dar una idea de la complejidad del problema y la necesidad de estudios interdisciplinarios, que seguramente han de prevalecer en el futuro.

Para poder discutir los factores relacionados con la tasa reproductiva del rodeo los hemos dividido en ambientales y genéticos, a estos últimos los vamos a discutir mas adelante junto con los caracteres a tener en cuenta en los programas de mejoramiento. En el Cuadro 1 se presenta una lista de los factores ambientales

Cuadro 1. FACTORES AMBIENTALES QUE AFECTAN AL COMPORTAMIENTO REPRODUCTIVO DEL RODEO

DEFICIENCIAS	MANEJO
Minerales	Ordene
Proteicas	Edad al destete
Energéticas	Primer servicio
Vitamínicas	Vacunaciones
ENFERMEDADES	Control de parásitos
Infecciosas	Epoca de monta
Parasitarias	de vaquillas
	de vacas
	Uso de inseminación

Resulta evidente y existen muchos trabajos de investigación que indican la necesidad de suplementación mineral sistemática con mezclas conteniendo los elementos menores junto con calcio, fosforo y sal. Esta es una práctica poco común en las explotaciones de trópico y que esta al alcance de cualquier establecimiento dada la sencillez para su administración y la baja inversión requerida. Es una práctica que no sólo debe figurar como consejo de extensión, sino que debería ser estimulada con medidas a nivel de gobierno de los países tropicales. La respuesta a esta suplementación en algunos casos son muy importantes como hemos oído en alguno de los trabajos presentados en este seminario con anterioridad, de manera que esta comisión desea hacer especial énfasis en la necesidad de su empleo sistemático. Es un factor que debe ser discutido por la comisión de nutrición pero deseamos hacer incapié en su importancia. Con respecto a las deficiencias de origen proteico, energético o vitamínico tambien deben ser discutidas por dicha comisión, pero deseamos señalar la necesidad de su evaluación así como el de la factibilidad ecónomica para suplirlas.

Otro aspecto que debe reconocerse como factor relacionado con la reproducción es el de la incidencia de enfermedades, nuevamente no es tema de nuestro grupo de trabajo pero creemos que es necesario ademas de su descripción una evaluación cuantitativa de la incidencia de cada una de ellas. Ello permitirá hacer un estudio económico que revele la importancia que cada enfermedad tiene en las distintas regiones del trópico.

Existen muy pocos trabajos que describan las distintas etapas del proceso reproductivo o cambios desde el punto de vista fisiológico que tienen lugar en diversas regiones tropicales; lo que hace difícil poder definir donde estan los problemas y por ende proponer soluciones. Sería útil disponer de mayor información sobre edad y/o peso relacionados con la aparición del primer celo, intervalos entre partos, aparición del estro luego del parto, etc. para distintas edades y condiciones de las hembras.

El ordeño es otra práctica que se incluye en el Cuadro 1 como factor que incide sobre el comportamiento reproductivo. Fueron mencionadas algunas cifras que indican lo importante que es esta práctica en algunas regiones tropicales. En Colombia, por ejemplo, alrededor del 55% de las vacas de hatos de producción de carne se ordeñan y el 70% de la leche comercializada en este país es de ese origen. Al ordeñe de las vacas está asociado un ingreso diario, lo que constituye una razón económica para su existencia en hatos de producción de carne, pero también se puede relacionar co una mayor mortandad de terneros, una disminución general de la fertilidad y con la factibilidad de un mejor control y mejoramiento del hato. En un sistema de producción con ordeño es factible por ejemplo emplear la inseminación artificial, técnica que probablemente no fuese aconsejable en otro sistema de manejo extensivo. De modo que con esta práctica pueden asociarse otros factores positivos algunos y negativos otros para la eficiencia de producción de carne, pero es un elemento que debe tenerse muy en cuenta cuando se formulan programas tanto de manejo como de alimentación, sanitarios y genéticos.

Otro factor que fue discutido fué la práctica del destete. Se reconoció la necesidad que el mismo se haga a la menor edad posible siempre que se disponga de alimento de calidad adecuada para reducir la penuria que este hecho ocasiona al ternero. La factibilidad del destete precoz (dos meses de edad o menos) debería de ser estudiada con precaución pues se lo reconoce como una práctica perteneciente a un nivel tecnológico elevado

que difícilmente se encuentre en el trópico en este momento.

El momento en que las vaquillas reciben su primer servicio no debe estar condicionado solamente por su edad sino que también el peso es de importancia, este ha de variar de acuerdo a los distintos genotipos por lo que sería necesario tener ambas variables en cuenta para poder recomendar en una zona determinada los valores mas adecuados a ese respecto.

Los programas de vacunaciones y de control de parásitos seguramente serán motivo de recomendaciones de la comisión de sanidad pero se reconoció la importancia potencial de la resistencia genética a determinados parásitos. Existen evidencias en la literatura mundial que indican la presencia de este tipo de resistencia por lo que el tema ha de ser sin duda investigado en el futuro tendiendo a la obtención de poblaciones o líneas que presenten dicha característica. La estimación de la heredabilidad de resistencia a garrapata en bovinos de que se dispone es de 0.4 valor que justifica la incorporación del carácter en los planes de selección.

Se reconoció la ventaja del establecimiento de épocas de servicio estacionales, ello permite un manejo racional de la reproducción. Existen diversos factores que condicionan la necesidad del estacionamiento de los servicios tales como disponibilidad estacional de forrajes, inundaciones en determinadas épocas del año,etc. En general se reconoció que el estacionamiento de los servicios no necesariamente está asociado con una disminución de la fertilidad. Lo que aparentemente parece ser un problema es pasar de un sistema continuo a uno estacional. Con un programa adecuado, tal como mover a las vaquillas y vacas secas por ejemplo, en pocos años es factible concentrar los partos en el momento mas adecuado. Por otro lado la parición estacional sería cuestionable en hatos de doble propósito donde interesa producir leche todo el año.

La época en que las vaquillas entran a servicio es aconsejable que se adelante un mes a 20 días con respecto a la fecha con que lo hacen las vacas. En general se reconoce la disminución de la tasa reproductiva en el segundo parto; con la práctica de adelantar los servicios de las hembras de primera parición se posibilita el tener un período mas prolongado entre parto y próxima concepción. No es aconsejable dar una segunda oportunidad de servicio a las vaquillas que no han parido o que no quedan preñadas luego de la época de monta si han entrado a la misma con el peso y la edad en que se espera obtener un comportamiento reproductivo normal.

El uso de inseminación artificial puede ser conveniente y es factible en aquellos establecimientos donde se hace un encierro diario de las vacas para ordeñe o evitar abigeato, por ejemplo. En determinadas circunstancias existen dificultades en la detección de celos, y a ello se lo asocia con determinados genotipos, de ser así esta práctica no sería aconsejable. La inseminacion artificial representa una ventaja económica, facilita el manejo sanitario del hato y es particularmente importante por la mejora genética que mediante su empleo puede hacerse o facilita la realización de cruzamientos.

Se reconoce la importancia de la revisión sistemática de los toros antes del servicio para asegurar la fertilización. Existen datos que tienden a senalar que la importancia de esta práctica no es muy grande en términos relativos con otros factores. En general el productor soslaya este problema mediante el uso de mayor número de toros.

Con respecto a los programas genéticos se consideró la mejora que puede hacerse del nivel de producción de carne. Los planes genéticos si bien son a largo plazo permiten introducir modificaciones permanentes en los hatos, estas pasan de una generación a otra, aunque en determinado momento los planes se abandonen, por lo menos parte de los cambios logrados seguirán siendo una característica de las generaciones venideras. Existen dos formas de expresión génica que fueron considerados; la primera se relacionan con los efectos geneticos aditivos y en base a ellos se realizan los planes de selección dentro de las razas puras. La otra forma la constituyen las expresiones genéticas no aditivas y éstas son las responsables de la heterosis efecto que se aprovecha al realizar cruzamientos.

Para las condiciones tropicales se reconoció la ventaja de las hembras producto de cruzamiento. Selección y cruzamiento no son mutuamente excluyentes sino que por el contrario se complementan dado que los caracteres que responden a heterosis no pueden ser facilmente mejorados mediante selección y por otro lado en los que se logra progreso por selección presentan una expresión de vigor híbrido bajo. De manera que es posible seleccionar en las razas puras que se utilicen en cruzamientos.

El empleo de cruzamientos en forma sistemática implica el poseer por lo menos dos razas puras adaptadas a las condiciones del trópico. Un aspecto de importancia en este caso es que las mismas tengan la mayor divergencia genética posible, por lo que una debería ser de origen índico y otra europeo. Se conocen razas de origen índico adaptadas y en número suficiente como para afirmar que se cuenta con una de las razas a ser empleadas. Existen problemas para encontrar una raza de origen europeo adaptada y en número suficiente. Las poblaciones que existían y que se las conoce con el nombre genérico de criollos, han desaparecido en gran parte de América Tropical. Sería importante apoyar programas tendientes a la conservación de aquellos grupos que aún quedan antes que terminen de desaparecer. Ellos pueden constituir una fuente genética importante en el futuro para la producción de hembras cruza.

Los reproductores que se empleen en la producción de carne, con servicios naturales o artificiales, deberían ser seleccionados en condiciones tropicales. Si bien se reconoce la utilidad de importación de material genético de otras regiones el hecho de que existan evidencias de la presencia de interacciones genético-ambientales hace que sea aconsejable la selección en el medio en el que se produce. La importación sistemática de animales o semen no debe ser considerada como una práctica aconsejable.

Un detalle que debe tenerse en cuenta al diseñar un plan de cruzamientos es la necesidad que el sistema produzca sus propias hembras de reemplazo. En ese sentido y particularmente en explotaciones de doble propósito seria aconsejable que entren a servicio un numero mayor de vaquillas de las que se requieren para reemplazo, lo que permitiría una evaluación de la aptitud lechera de las hembras antes de efectuar la selección.

El sistema de cruzamientos alternado con dos razas parecería ser el que mayor posibilidades tiene en este momento; las cruzas terminales no aparecen como factibles aun dado que exigen una alta tasa reproductiva en las razas puras como para producir los reemplazos. Los planes definitivos deben hacerse teniendo en cuenta el nivel de capacidad de

manejo y la disponibilidad de instalaciones.

Entre los caracteres que se consideraron a tener en cuenta en planes de mejoramiento genetico que se presentan en el Cuadro 2 se encuentran los relacionados con la reproducción, la mayoría de ellos responden a heterosis, por lo tanto como se expresara anteriormente es necesario el empleo de hembras cruza, que además poseen una vida útil más prolongada y son mejores madres.

Cuadro 2.- CARACTERES QUE DEBERIAN SER CONSIDERADOS EN PROGAMAS DE.MEJORAMIENTO GENETICO.

Tasa reproductiva

Mortandad de terneros

Dificultades de parto

Velocidad de crecimiento

Aparición de la pubertad

Características de la canal

Tamaño adulto
de los machos
de las hembras

Producción de leche

Habilidad materna

La selección dentro de las razas puras debe hacerse en el caso de explotaciones de doble propósito tendiendo a aumentar la producción de leche y teniendo en cuenta como en los demas hatos ademas las características de crecimiento y de la canal. Se señaló de que por lo menos ya existe una asociación de criadores de ganado puro que ha aumentado el enfasis que se le asigna a la producción de leche en la clasificación de animales vivos.

El esfuerzo en mejorar las características de crecimiento y de la canal debe ser compensado con un mejor precio por unidad de peso en el momento de la faena. En la mayoría de los mercados de América Tropical no existen sistemas de clasificación de las canales que permitan apreciar diferencias entre las mismas. Por lo tanto sería util que los gobiernos en los países de esta zona establecieran sistemas de clasificación que permitan la diferenciación de los precios acorde con los distintos tipos. Estos sistemas deben describir la edad, conformación y deposición de grasa ello permitirá que el ganadero reconozca lo que produce, lo que hara que la selección sea más efectiva, estimulando al mismo tiempo a aquellos que llegan al mercado con un producto de mayor calidad y/o mayor valor.

Por último los integrantes de la comisión reconocieron la necesidad de apoyar las investigaciones a largo plazo en materia de reproducción y genética. En ese sentido se señaló la falta de continuidad de este tipo de programas por falta de apoyo de las instituciones oficiales en forma continua o por el cambio de funciones a que se ven sometidos los técnicos que tienen a su cargo esos trabajos. Se señaló que es muy importante el intercambio de información entre los grupos que trabajan en producción de carne en el trópico, mediante este tipo de reuniones ese intercambio se hace efectivo.

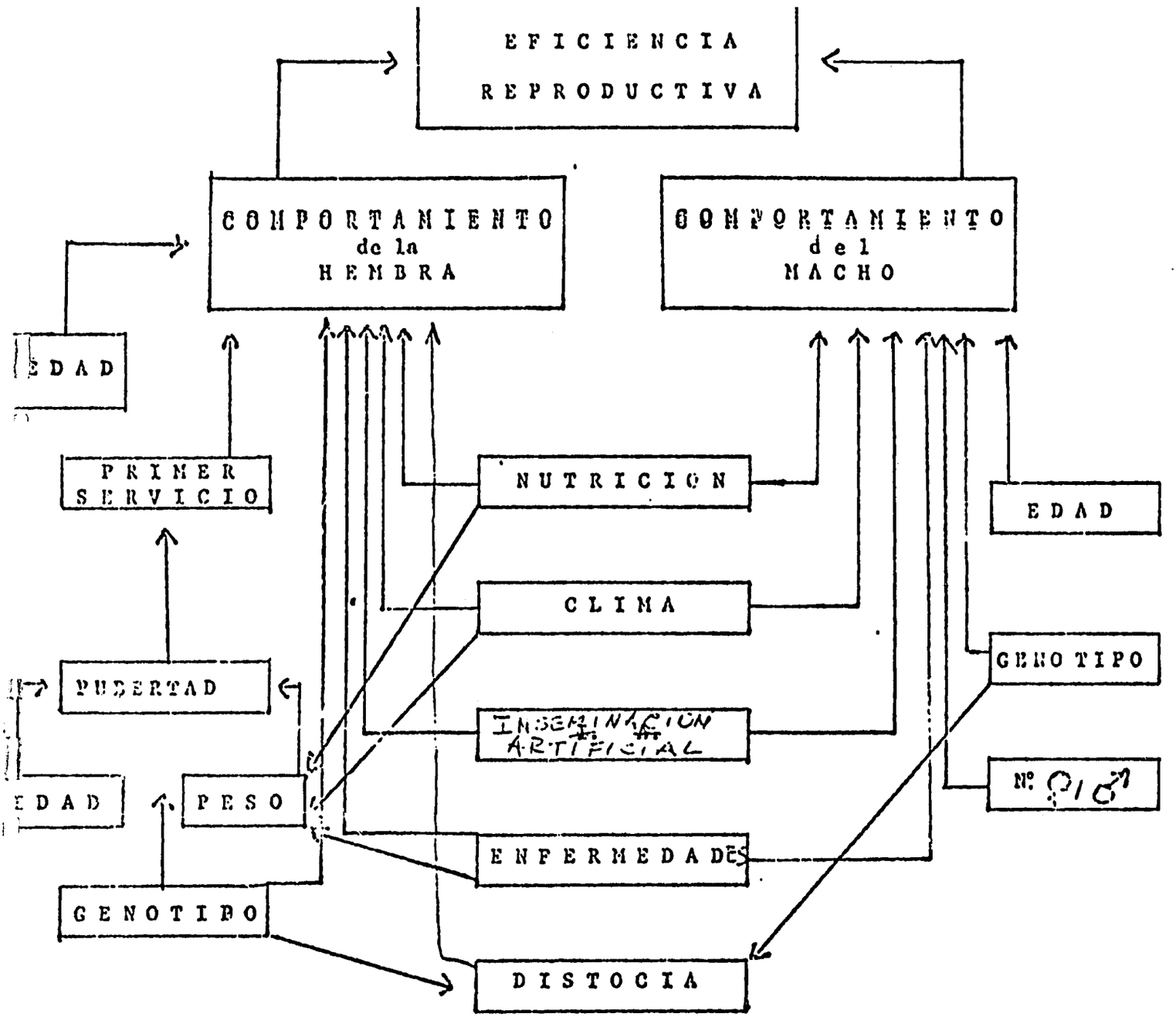

Figura 1.- ALGUNAS VARIABLES RELACIONADAS CON LA EFICIENCIA REPRODUCTIVA DE HATO

FINAL REPORT OF MR. JAMES R. SIMPSON'S AND DR. DONALD E. FARRIS' TRIP TO SOUTH AMERICA, JULY 16, 1973 TO SEPTEMBER 9, 1973

Funded through Grant No. AID/CSD 3675, "Expanding Competence in the Design and Execution of Livestock Development Programs in the Tropics Emphasizing Ruminant Livestock Production Systems Through Improved Breeding and Disease Control."

Countries Visited

Argentina, Brazil, Colombia, Paraguay and Uruguay

Major Objectives of the Trip

1) Collect data and information to enable James R. Simpson to complete his Ph.D. thesis tentatively titled "World Trade in Processed Beef and Economic Development of Selected South American Countries."
2) Permit Don Farris to obtain data and other information to supplement other aspects of the research program in International Trade in Beef at Texas A&M.

Specific Objectives

1) Contact beef industry and allied interests relative to developments, data and available studies on production and exports of semi and extensively processed beef (frozen boneless, cooked-frozen, and canned).
2) Locate input-output studies on the economies of the above countries when available.
3) Interview beef packers and obtain sufficient financial data to allow disaggregating and rebuilding several countrywide input-output studies in order to measure the economic multiplier effect from the sale of different types of beef exports, i.e. chilled or frozen quarters, chilled or frozen bone-in and bone-out wholesale and retail cuts,

cooked-frozen beef, and canned beef.

4) Obtain estimates of data to support the annual production of beef and beef exports to 1985 for each of the five countries.

5) Obtain a better knowledge of the relationship between the various types of beef exports from the 5 countries.

6) Obtain a better understanding of the relationship between the five countries and the rest of the world, i.e. both beef importing and exporting countries.

Progress on Completing the Objectives

This section will be set forth from a chronological point of view rather than as related to the objectives per se. An evaluation of the success in meeting each objective will be given in the final section however. As a preface it should be noted that the first contacts in each country were with either USAID officials or the agricultural attaché. Their advice and assistance was very helpful.

July 16

Departed from College Station in the morning and interviewed executives of Deltec International Limited, a subsidiary of North American Foods located in Coral Gables, Florida. This company, a few years ago, exported more canned beef from South America than any other firm. The meeting was very successful. We obtained specific cost data (from now on this term will refer to data needed for the multiplier analysis), other contacts in the five countries, and a good general perspective of the changing economic situation in the beef export industry.

July 17-20

The first two of these days were spent at the Centro Internacional de Agricultura Tropical (CIAT) in Cali. The purpose was to obtain a better understanding of the way in which production problems would affect future Latin American beef exports and those of Colombia in particular. This center is one of the leaders in Latin American beef cattle research. We exchanged several publications with the team at CIAT.

The second two days were spent in Bogotá visiting beef slaughter houses and arranging for visits to two packers near Baranquilla who are packing for export. The objective was to visit these packers on the way back to College Station.

July 21, 22

Enroute to Asuncion, Paraguay.

July 23-29

This period of time was spent in Asuncion, Paraguay. We interviewed at great length executives from the United States owned International Products Company and the English owned Liebieg's Extract of Meat Company. Tours were made of the plants and excellent cooperation was received. These packers as well as all others we interviewed were very interested in Simpson's Ph.D. thesis subject, feeling that it was timely and quite relevant to one of their current decision problems, i.e. how much emphasis should be given to canned beef and other beef product lines as a percentage of their exports. This problem is crucial today (September, 1973) as the price relationship has turned around in the last year to favor chilled beef rather than canned.

Contacts were made with two smaller packing plants, CODEGA and PAMPA. Information was obtained from the Ministry of Agriculture as well.

A seminar on changing world price relationships and their significance to North and South America was presented by Dr. Farris to a group of cattlemen from the Association Rural, the Paraguayan cattlemen's association (Simpson interpreted).

Collaboration was also extended to Dr. William Capner, a New Mexico State University agricultural economist on leave to Paraguay to do a special report on marketing beef cattle in Paraguay.

July 30-August 3

These five days were spent in Montevideo, Uruguay. The majority of the time and visits were arranged by Texas A&M University staff member James McGrann who is on the Texas A&M Technical Assistance Team there. Thanks to prior planning and contacts a great deal of information was obtained in a relatively short time.

Visits were made to Frigorifico Canalones, and Frigorifico Nacional. The former is a new plant and the latter quite old. Very good cost data were obtained and the interviews resulted in considerable understanding of the Uruguayan beef export situation. This was further heightened by extensive interviews with World Bank, Uruguayan Central Bank and numerous Uruguayan Ministry of Agriculture officials. Collaboration on technical aspects of input-output models was also given to one technician of the Ministry of Planning. An input-output study for Uruguay was located and a copy obtained.

August 4-13

These 10 days were spent in Buenos Aires. Extensive assistance was given during this period by Dr. John Steele, Texas A&M staff member who is Chief of Party on the A&M/Michigan State/Penn State Technical Assistance Team to Argentina.

Our first principal contacts were Dr. Carlos Gaviola, head of the Cámara Argentina de la Industria Frigorifica and Dr. Alberto de las Carreras, president of the Asociacion de Industrias Argentinas de Carnes. These two men in turn were fundamental in our obtaining collaboration and fine cooperation from the following meat packers: Meatex, Swift de la Plata, and Pedro Hermanos. These interviews and visits took an average of two days each.

Contacts were also made with the Junta Nacional de Carnes for further general information as well as the Ministry of Planning where updated, input-output studies were obtained. Several contacts with cattlemen were made and considerable information on production problems was obtained.

August 14-19

The 15th and 16th were spent visiting the plant of COMABRA, an Argentine owned canned beef exporting packer in São Paulo which purchased the old Wilson plant. Cost data was obtained as well as a good review of the Brazilian beef export trade.

The 17th was spent with executives from Swift-King, an integrated ranching and slaughter operation. It is partly owned by King Ranches (of Texas) and partly by a Brazilian organization. The Brazilian part has two large packing plants in Southern Brazil which we did not visit due to time limitation.

Saturday and Sunday (18th and 19th) were spent visiting four of the King-Swift ranches in the western part of the state of São Paulo. This was an especially productive time in that it enabled us to obtain a better insight into ranching operations in Brazil as well as estimations of future production. At the same time a Uruguayan rancher (educated at Kansas State) was visiting the ranch. Our discussion primarily involved contrasting U.S., Uruguayan and

Brazilian ranching.

August 20-August 29

This period was spent in São Paulo at the XV International Congress of Agricultural Economists. Simpson presented a paper "Application of an Economic-Demographic Simulation Model to Planning in Paraguay." Considerable contact was made with agricultural economists from Europe, Australia and Africa who are working in the area of livestock production and trade. It was a rare opportunity to find, in one spot, specialists who were able to render opinions on the production and imports or exports of beef from their various countries. This should give considerably more authority to the thesis and subsequent publications.

Contact was also made with Ministry of Agriculture representatives, especially in marketing as well as with researchers from Instituto de Pesquiza Economicas (IPE) from which it is hoped an input-output study for Brazil can be located.

Dr. Farris returned to the United States on August 24.

August 29-30

The rest of the chronological part of this report refers to James R. Simpson's trip. The 29th and 30th were spent in Brazilia attempting to locate an input-output study for Brazil (without success). Visits were made with the R.D.O. of USAID/Brazil as well as the Economic Officer of the U.S. Embassy, primarily on the question of the future of the livestock industry in Brazil (especially northern Brazil which is now in early development stages).

August 31, September 1-2

Friday, the 31st was spent in traveling to Fortaleza, Brazil, and the other three days were spent there. Sunday was spent out in the cattle growing area of the country. September 3 was primarily devoted to consulting with

members of the University of Arizona Technical Assistance Team to the University of Ceará on M.S. theses related to the livestock industry.

September 4

Tuesday, August 28 was spent in Belem, Brazil talking to members of an IICA (Instituto Internacional de Ciencias Agropecuarias, a branch of OAS) team on problems of agriculture in the state of Pará, Brazil.

September 5

Enroute to Bogotá, Colombia

September 6-8

An opportunity to visit several large cattle ranchers on the north coast of Colombia was offered by Dr. Jaime Cuellar, manager of INOUGAN, a company which controls about 70,000 head of cattle. Given that sufficient cost data had already been obtained from earlier contacts, this opportunity was taken and the earlier contacts with the two packers (through Dr. Cuellar) were cancelled. This was a fine chance to observe ranching methods here as well as discuss possibilities for the future development of Colombia's livestock production and subsequently, exports.

September 9

Return to College Station

Completion of Major Objectives

1) More than enough data was obtained for James R. Simpson to complete his Ph.D. thesis.

2) Substantial data, contacts and first hand information were obtained on the South American Beef Export Industry by Don Farris

Subordinate Objectives

1) We made as many contacts during this 7-week period with both private industry as well as academic and government officials as could be hoped for. This part was a very interesting and productive experience. Physical and cost data on beef packing plants were obtained on a variety of product lines in all countries except Colombia.

2) Input-output studies were located for Brazil (an updated one is being prepared and will be sent) as well as Uruguay. Two updated studies were located for Argentina. These were more than we expected to find.

3) Fine cooperation by the beef packers was found and we obtained the necessary data for measurement of the economic multiplier effects.

4) Estimates of annual production were obtained. A complete report on these will be included as an integral part of the Ph.D. thesis.

5) The results of this objective will also be presented in the thesis. It is too detailed for presentation in this summary.

6) The contacts made with the two beef packer's associations mentioned earlier, interviews with packers and visits at the IAAE meetings in São Paulo with scholars working on these problems all contributed to the successful completion of this objective.

TITLE: Simulation of Beef Cattle Production Systems

APPENDIX VII

LOCATION: Animal Science Department, Texas A&M University, College Station, Texas and U.S. Meat Animal Research Center, Clay Center, Nebraska

PERSONNEL INVOLVED:*

T.C. Cartwright, Professor, Animal Science Department
Texas A&M University

C.R. Long, Assistant Professor, Animal Science Department
Texas A&M University

J.O. Sanders, Research Associate (proposed)
Animal Science Department, Texas A&M University

C.M. Smith, Research Leader, Management Systems
U.S. Meat Animal Research Center

*It is anticipated that additional personnel will be involved in the U.S. MARC efforts.

COOPERATION: Animal Science Department, Texas Agricultural Experiment Station, Texas A&M University System; and the U.S. Meat Animal Research Center.

DATE OF INITIATION: September 1, 1974

EXPECTED TERMINATION DATE: August 31, 1979

TECHNICAL APPROVAL:

T. C. Cartwright — Date 5-16-74
Professor, Animal Science Department
Texas A&M University

Gerald L. Smith — Date 5/13/74
Research Leader, Management Systems,
U.S. Meat Animal Research Center

CONCURRED IN:

Jack E. Miller — Date 5/30/74
Director, Texas Agricultural Experiment Station

Dick E. Gregory — Date 6/3/74
Director, U.S. Meat Animal Research Center

C. R. Butler — Date 5-17-74
Head, Animal Science Department
Texas A&M University

OBJECTIVES:

1. To develop a biologically sound model with economic inputs for simulating beef cattle production at the herd level using individuals as the basic unit for model construction.

2. To validate the model or components by use of data already collected by TAES and the U.S. MARC, published and unpublished, and to consider designing research or altering design of existing research in order to furnish data required for modeling or suitable for validation.

3. To simulate chosen sets of alternative production systems of varying economic, managerial, nutritional, other environmental and genetic parameters relating to breeding systems and selection criteria for beef cattle.

4. To adapt the beef production model for simulating sheep and swine production to the extent adaptation is feasible and to develop new components if necessary.

JUSTIFICATION:

The net efficiency of different systems of meat animal production is a function of genetic and environmental inputs and their interactions. Interactions become numerous and complex especially when the environment is considered to include managerial capability, marketing constraints, credit and other socio-economic effects. Experimental evaluation of the efficiency of different systems is complicated by the need for simultaneous comparisons of the many alternatives and by the tremendous cost in both time and money. For example, the efficiency with which a given set of environmental resources are utilized to produce beef may vary considerably among various alternative uses of the existing genetic resources. Conversely, the use and efficiency of production of a given set of genetic resources may vary according to the environmental resources. In real life one set of resources is not fixed and the other adjusted, but rather they tend to be simultaneously adjusted which requires testing almost without limits. These limitations can be overcome to a large degree by using mathematical models to simulate meat animal production systems. Computer simulation techniques developed by Forrester (1961) have been used successfully for similiar purposes; e.g., evaluation of selection plans in poultry and swine (Smith, 1964), comparison of crossbreeding systems (Moav, 1966a,b), comparison of natural service vs. AI for improvement of dual purpose cattle (Lindhe, 1968) and study of poultry production systems (Fawcett, 1970). Modeling techniques were used in studies at Texas A&M (Long and Fitzhugh, 1970; Long, Fitzhugh and Cartwright, 1971a,b) of factors affecting efficiency of beef production and later were extended into broader studies to compare simultaneously alternative selection goals, mating plans, nutritional regimes, managerial decisions and marketing procedures (Long, Cartwright and Fitzhugh, 1974; Fitzhugh, Cartwright and Long, 1974; and Cartwright, Fitzhugh and Long, 1974).

As technology and economics become more and more dynamic, the need to respond more rapidly becomes greater. For example, during the past decade, especially, bovine semen has been relatively widely and expeditiously distributed. This development increases the genetic variability available for use in commercial production and, hence, tends to increase the opportunities for increasing efficiency of production and the capability to adjust to changing environment through the judicious choice of breeding systems. At the same time, this availability of a large array of genotypes may compound the seriousness of imprudent choices of

breeding systems.

The capability of public research institutions to respond directly to guide implementation of technology and to evaluate its overall effects would be an asset to producers and consumers. The capability to evaluate and respond indirectly back through research channels is also an asset, and though less visible, perhaps just as important. The value of a concerted effort in systems analyses is multiplied especially in the latter context if many institutions depend on guidance from results of the concerted effort.

PROCEDURES:

1. A general beef production model currently being developed in the Animal Breeding Section, Animal Science Department at Texas A&M University will be completed during the summer of 1974 and will be made available to the U.S. MARC for direct use or adaptation. The details of this model will be prepared for publication by September 1, 1974. After September 1, 1974, one 3/4-staff member and at least three graduate students will continue to work with various aspects of altering, validating, and "fine tuning" the model as well as simulating various alternative systems. This activity will be funded through an AID 211d grant, which will continue until June 30, 1977, and will be directed toward tropical beef production.

2. The U.S. MARC will enter into active beef, sheep and/or swine modeling, simulation or related activities as funds and personnel become available giving especial emphasis to filling in or complementing the related TAES research activities. This research is outlined in more detail in the attached statement entitled "Management Systems Research at the U.S. Meat Animal Research Center" which was developed in April, 1974. The U.S. MARC developments in modeling and simulation will be made available to TAES the same basis as TAES work is to be made available to the U.S. MARC.

3. TAES and the U.S. MARC will supply data collected, published and unpublished, which are suitable for developing or validating the model or its components. Each set of data exchanged and its specific use will be discussed and a letter outlining the agreement on use will be filed.

4. The personnel involved at TAES and the U.S. MARC will meet at least once a year to confer and collaborate on model development, validation and simulation. In addition they will, as a result of this modeling and simulating activity, develop:

   a. A listing of priority research in beef production and the rationale and documentation for the listing.

   b. A listing of suggested alteration of existing research projects based on (a.) above and an outline of the basic design alteration.

   c. Outline of new research projects suggested for TAES and the U.S. MARC related to beef, sheep or swine production.

5. Publication of results, authorship, and acknowledgements will be mutually agreed upon by TAES and the U.S. MARC and will reflect the established policies and standards of the scientific community to fairly and equitably recognize the contribution of each person and institution involved. Either TAES or the U.S. MARC may elect to not be cited and to not have their data or contribution published either jointly or separately. In any case, full opportunity will be given both TAES and the U.S. MARC to review any publication or release involving joint effort described in this agreement.

Literature Cited

Cartwright, T.C., H.A. Fitzhugh, Jr. and C.R. Long. 1974. Systems analysis of sources of genetic and environmental variation in efficiency of beef production: mating systems. J. Anim. Sci. (in press).

Fawcett, R. 1970. An optimal solution for a poultry breeding operation. Proc. British Poultry Breeders Roundtable.

Fitzhugh, H.A., Jr., T.C. Cartwright and C.R. Long. 1974. Systems analysis of sources of genetic and environmental variation in efficiency of beef production: heterosis. J. Anim. Sci. (in press).

Forrester, J.W. 1961. Industrial Dynamic. M.I.T. Press, Cambridge, Mass.

Lindhe, B. 1968. Model simulation of AI-breeding within a dual purpose breed of cattle. Acta Agriculturae Scandinavica 18:33.

Long, C.R. and H.A. Fitzhugh, Jr. 1970. Efficiency of alternative beef breeding systems. Texas Agr. Exp. Sta. Prog. Rpt. 2789.

Long, C.R., H.A. Fitzhugh, Jr. and T.C. Cartwright. 1971b. Breeding system evaluation using polyperiod models. J. Anim. Sci. 33:202. (Abstr.).

Long, C.R., T.C. Cartwright and H.A. Fitzhugh, Jr. 1974. Systems analysis of sources of genetic and environmental variation in efficiency of beef production: cow size and herd management. J. Anim. Sci. (in press).

Moav, R. 1966a. Specialized sire and dam line. I. Economic evaluation of crossbreds. Anim. Prod. 8:193.

Moav, R. 1966b. Specialized sire and dam lines. III. Choice of the most profitable parental combination when component traits are genetically nonadditive. Anim. Prod. 8:365.

Smith, C. 1964. The use of specialized sire and dam lines in selection for meat production. Anim. Prod. 6:337.

MANAGEMENT SYSTEMS RESEARCH
at the
U.S. Meat Animal Research Center

Objectives. Resources available for the production of meat animals include soil, water, plant and animal germ plasm, capital, labor, and physical facilities and equipment. The available mix and costs of these resources plus market requirements determine the relative efficiencies of different production strategies. Management systems is the organization of production resources to maximize their "conversion" rate through the optimum integration and coordination of economics and technology. Inherent in this organizational process is the identification and the evaluation of additional technological requirements.

Recognition of the critical need for greater understanding of resource and technology management to provide for integrated approaches in meat animal production has led to the formation of the Management Systems Research Unit at the U.S. Meat Animal Research Center with the following objectives.

A. Identify and evaluate resources and technology of potential use in the production of meat animals and make general recommendations for their development, use and/or allocation.

B. Develop specific production "equations" to maximize meat production per unit of resource use for each of the many resource-market-technology situations representative of all segments of meat animal agriculture in the United States.

C. Identify and establish relative priorities of research needs in all areas of meat animal production.

Research Methods. The evaluation of resource allocations and/or production alternatives necessitates the use of simulation models. There are, however, many levels of sophistication in modeling. Management systems research will consist of two phases. The first of which will utilize ad hoc modeling techniques to combine economic and production considerations for early assessment of production strategies and/or research plans. The second phase will involve the development and subsequent economic evaluation of biological models. These biological models, which become the core components of larger bioeconomic models, will describe in quantitative terms the resource use and product output for any given production strategy. The subsequent economic evaluation of these biological input-output models will establish the relative efficiencies of different production "equations". This stepwise construction of bioeconomic models will allow the assessment of both the biological and economic

efficiency of production strategies, as well as, offer flexibility for changes in market conditions.

The construction of livestock biological models will consist of (1) development of dynamic models of herd structure dependent on the reproduction and attrition rates of each herd segment; (2) characterization of various production systems in terms of the reproduction and attrition rates needed to determine herd structure; and (3) quanitative description of input requirement (e.g., nutrition, labor, facility) and product yield of each segment of the herd. These livestock biological models will then be interfaced with dynamic feed production models in order to synchronize animal performance capability with production resource "mix". The opportunity to study the interplay of different biological models (e.g., cattle and forage) is one of the most promising aspects of systems research.

Experimentation. Some experimentation will be necessary to assess labor requirements of management activities (e.g., farrowing, shearing, feeding, A.I., etc.) with various types of physical facilities and equipment, as well as animal performance levels for different feed resource-labor-facility combinations. In fact, this is the only experimentation which is intrinsic to management systems research. It is anticipated that these experiments can be run concurrent with the testing or validation of various segments of biological models. The extent to which such testing of models and management-activity experimentation is necessary, useful, or feasible will depend both on the probable value of the information being sought and on the species involved. It is doubtful that the validation of complete bioeconomic models would ever be a judicious use of research resources; however, the possibility of testing complete models through consulting-information feedback agreements with commercial sectors of animal agriculture should be carefully considered.

Cooperative Research. Management systems research offers two excellent opportunities for cooperative research with other interested groups. The first of these is in the actual development of simulation models. There is little need for the separate development of basic bioeconomic models since they must have the capability of correctly responding to all reasonable resource "mixes" and market conditions. The second opportunity for cooperative research involves the establishment of production and economic parameters characteristic of various regions in order to expand the applicability of simulation results. Specific management strategies are valid only to the extent that resource availability, animal performance and market requirements are similar to the assumptions of the model.

Research Planning. A major result of attempting to systematically organize information is the identification of missing components. Simulation modeling provides this identification, as well as, allows the examination of the relative importance of the missing data. This

evaluation of missing information is done by sensitivity of production decisions to alteration of the values. By this identification and relative assessment of information gaps, management systems research will have a major influence on all research conducted at the U.S. Meat Animal Research Center. Management systems research offers an opportunity to try bold and imaginative approaches to both research management and production alternatives.

CONCLUSION. Animal production is analogous to the organization of many separate pieces of a large constantly changing jig-saw puzzle. Management systems is that discipline which fits these pieces together into coherent and efficient production strategies. An extremely important by-product of this effort to systematically organize available information is the identification of those puzzle pieces which are missing and their relative importance to the evaluation of production alternatives. It is also necessary to anticipate the completed picture, not only to aid in its assembly, but also because current production and research planning decisions must be made with today's information.