DRAFT-11/15/51

CONFERENCE ON RUMEN FUNCTION
Congress Hotel
Chicago, Illinois
November 27-28, 1951

Introductory Remarks — B. T. Simms

November 27, 1951

Panel Discussions

Rumen Physiology - Dr. Carl Huffman, Michigan, Chairman; Wise Burroughs, Iowa; Beeson, Indiana; Forbes, Illinois; and Paul Pierson, A.E.C., leaders

Microbiology of the Rumen - , Chairman; A. L. Bortru, Pennsylvania State; Gall, ; Hastings, Wisconsin; Amadon, University of Pennsylvenia

The Rumen for the Veterinary Viewpoint - Daugherty, Cornell, Chairman; Shalk, Ohio; Pomden, Ohio; Bourne, Colorado; and Harshfield, South Dakota, leaders

Livestock Management in the Prevention of Bloat - H. H. Cole, California, Chairman; Foster, Maryland; Otto Sell, Georgia; Wise, North Carolina, leaders

This panel should include problems of grazing and dry lot feeding as related to bloat

The Agronomists' Interest in the Problem of Rumen Function - W. K. Kennedy, Cornell, Chairman; Sullivan, Pasture Laboratory, BPISAE; Mott, Indiana; E. M. Brown, Missouri; Peterson, California; H. L. Ahlgrem, Wisconsin; and N. R. Ellis, BAI, leaders

It is suggested that Chairmen of the Panels develop questions from the discussion to be considered in drawing up later recommendations.

Charge to the Panels for drawing up recommendations

November 28, 1951

9 AM - 12 N - Meeting of Panels to develop recommendations as to the phases of research needed to fill existing gaps in our existing information. These recommendations should be a guide to research workers interested in the part played by the rumen in digestion of feed and to those interested in the prevention of bloat.

1 PM - Report of Panel Chairmen on recommendations. Drawing up ~~of~~ and approval by group of a program on rumen function.

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Auburn, Alabama

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Colorado A & M College
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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
WASHINGTON 25, D. C.

OFFICE OF ADMINISTRATOR

November 1, 1951

(Letter to the Deans of the Schools of Veterinary Medicine)

For a number of years the Agricultural Experiment Stations and the Department of Agriculture have been advocating the improvement of pastures. The program of pasture improvement has presented many problems which require research to furnish the solutions. Among these problems is the area concerned with the effective utilization of pasture by livestock.

In many parts of the country improved pastures involve the inclusion of legumes not only for the increased nutritive value of the herbage but also for the improvement of the soil. In recent months we have received many requests for information on what can be done to assist in preventing the cases of bloat that frequently occur among cattle and sheep grazing upon such pastures. I am sure that you have also received numerous requests for similar assistance.

It seems desirable, therefore, to ask research workers who are working on rumen function to get together and plan a program that will assist the livestock producers in utilizing such improved pastures with less danger to the health of their animals.

Because many workers who would be able to contribute to such a program will be in attendance at the meeting of the American Society of Animal Production and the Conference of Research Workers in Animal Diseases in North America, we feel it would be advantageous to get the interested workers together at that time. Accordingly, we are arranging for a meeting to be held at the Congress Hotel, Chicago, Illinois, on November 27 and 28, 1951. The meeting to open at 9 AM on November 27. This would serve to reduce the cost of travel for those participating.

To be most effective a program of the type described should be developed as a result of broad participation by all of the talent available. In order to achieve this wide base of scientific background, the Department plans to have representatives of our pasture, livestock and veterinary research programs at the meeting. It is hoped that those members of your staff who are interested in this subject may also attend.

We would appreciate learning the names of any members of your staff who may attend.

Very truly yours,

Administrator

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
Office of Administrator
Washington 25, D. C.

January 10, 1952

TO : Participants in Conference on Rumen Function

FROM : H. W. Marston, Research Coordinator, Agricultural Research Administration, U.S.D.A., Washington 25, D. C.

SUBJECT: Report of Conference

Attached is a copy of the notes on what transpired at the Conference on Rumen Function, held at the Congress Hotel, Chicago, Illinois, on November 27 and 28, 1951.

These notes are not verbatim but are an attempt to record the expressions of those who participated in the discussions. You will recognize that many items have been omitted but I believe I have recorded the general temper of the meeting.

Someone has suggested that it would be highly desirable to accumulate a list of references that would be of value to those interested in the problem of bloat. It is quite likely that those attending our Conference were quite familiar with the literature in their special field but had had only limited access to reports of research in the other fields of discussion into which the Conference was divided. If you feel that such a compilation would be of value, I would be glad to undertake the task of putting the material together. In order to compile this list of references, I would appreciate you sending me, in a form that would conform to the divisions of our discussions at Chicago, the name of the paper, the author or authors, place of publication, and date of material which you feel would be pertinent. I do not believe that it should be necessary to repeat the long list of references compiled by authors of the article on bloat which appeared in the August, 1945, issue of the Journal of Animal Science.

When this compilation has been completed, I will be happy to send you copies for your information and files.

REPORT ON
CONFERENCE ON RUMEN FUNCTION
Held At
Congress Hotel, Chicago, Illinois
November 27 and 28, 1951

The meeting was called to order at 9:00 AM on November 27, 1951.

The following persons were in attendance during the two-day meeting:

NAME	INSTITUTION
Howard W. Johnson	BAI, USDA, Washington, D. C.
H. W. Schoening	BAI, USDA, Washington, D. C.
James K. Lewis	An. Hus. Dept., So. Dakota State College
T. J. Cunha	University of Florida
N. R. Ellis	BAI, USDA, Washington, D. C.
William J. Murphy	College of Agri., Uni. of Missouri
Hugh C. McPhee	BAI, USDA, Washington, D. C.
T. C. Byerly	BAI, USDA, Beltsville, Maryland
H. H. Brugman	University of Maine
W. W. Green	University of Maryland
J. C. Miller	Texas A & M College
J. D. Francioni, Jr.	Louisiana State University
W. K. Kennedy	Cornell University
J. A. Jacobs	University of Illinois
G. S. Harshfield	South Dakota State College
R. C. Baskett	British Embassy, Washington, D. C.
R. E. Nichols	University of Wisconsin
E. R. Barrick	North Carolina State College
Thomas J. Jones	University of Georgia
E. H. Livesay	University of West Virginia
E. W. Klosterman	North Dakota Agricultural College
L. S. Gall	National Dairy Research Laboratory, Oakdale, Long Island, N. Y.
H. D. Eaton	University of Connecticut, Storrs
Wilson B. Bell	Virginia Agricultural Experiment Station
Dwight Espe	OES, USDA, Washington, D. C.
R. E. Hodgson	EDI, USDA, Washington, D. C.
Leslie E. Johnson	BAI, Lincoln, Nebraska
W. D. Pounden	Ohio Agricultural Experiment Station, Wooster
J. K. McClarren	BAI, USDA, Washington, D. C.
Ray Dankenbring	Farm Journal, Philadelphia, Pa.
John H. Helwig	College of Veterinary Medicine, Ohio State University

NAME	INSTITUTION
Wise Burroughs	Iowa State College
H. E. Redmond	Texas A & M College
W. L. Sippel	University of Georgia, Tifton
A. M. Lee	BAI, USDA, Washington, D. C.
W. G. Kammlade	University of Illinois
F. J. Keilholz	Country Gentleman, Philadelphia, Pa.
C. L. Davis	BAI, USDA, Denver, Colorado
L. A. Moore	BDI, USDA, Washington, D. C.
G. R. Carlisle	University of Illinois
K. E. Gardner	University of Illinois
J. T. Reid	Cornell University
Eugene Meyer	Hoard's Dairyman, Fort Atkinson, Wis.
W. L. Boyd	University of Minnesota
Henry H. Leveck	State College of Mississippi
B. F. Barrentine	State College of Mississippi
Warren Gifford	University of Arkansas
J. T. Sullivan	EPISAE, USDA, State College, Pa.
W. E. Thomas	University of Kentucky
C. F. Huffman	Michigan State College
W. E. Dent	J. J. Astor Experiment Station, Astoria, Oregon
R. W. Dougherty	New York State Veterinary College, Ithaca
R. S. Sugg	School Veterinary Medicine, Auburn, Alabama
W. D. Salmon	Alabama Polytechnic Institute, Auburn
H. H. Cole	University of California, Davis
M. A. Hein	BPISAE, USDA, Beltsville, Maryland
C. S. Hobbs	University of Tennessee
Jesse Sampson	University of Illinois
E. Marion Brown	University of Missouri
D. F. Beard	BPISAE, USDA, Beltsville, Maryland
D. W. Colvard	North Carolina State College
C. K. Whitehair	Oklahoma A & M College
B. T. Simms	BAI, USDA, Washington, D. C.
A. T. Phillipson	Rowett Res. Institute, Aberdeen, Scot.
O. S. Aamodt	BPISAE, USDA, Beltsville, Maryland
Cecil Elder	University of Missouri
Carl Schlotthauer	Mayo Foundation, Rochester, Minn.
R. J. Webb	Dixon Springs Experiment Station, Robbs, Illinois
M. E. Hansfield	Dixon Springs, Experiment Station, Robbs, Illinois
C. A. Manthei	BAI, USDA, Beltsville, Maryland
H. W. Marston	ARA-CA, USDA, Washington, D. C.

For the purposes of the conference, the program was divided into five panels for discussion purposes. The name and chairman of each of these panels was as follows:

(a)	Rumen Physiology	-	Dr. C. F. Huffman
(b)	Physio-Pathology	-	Dr. R. W. Dougherty
(c)	Agronomic	-	Dr. W. K. Kennedy
(d)	Animal Management	-	Dr. H. H. Cole
(e)	Microbiology	-	Dr. W. D. Pounden

RUMEN PHYSIOLOGY

Dr. R. W. Dougherty opened the discussion by stating that, in his opinion, the toxic gas theory as related to bloat was a misnomer. He is at present working with unknown substances found in the ingesta and the plant to ascertain the possible relation to bloat. Some of the characteristics of the material have been determined but no substance has been identified. Dogs are being used as test animals. It is assumed that the active substance of the material affects the nervous system. He has not been able to produce bloat in cattle with the material.

Dr. W. E. Thomas reported that a juice had been extracted from alfalfa and ladino clover which will produce bloat regularly, especially if animals have been on pasture for 24 hours. A pint of the juice will produce bloat in cattle. One pint of the extract will kill sheep in from 1 to 1½ hours, while one pint of extract made from birdsfoot trefoil will kill sheep (70 pounds) in about 10 minutes. Sodium thiosulfate, 20 to 25 grams, will save the sheep. The reaction of the animal appears similar to HCN poisoning. Approximately 30 ounces of the extract can be prepared from 10 pounds of alfalfa. The extract was prepared by running the alfalfa through a cane mill.

Dr. H. H. Cole observed that in sheep bloating on alfalfa the pain spasms which caused the animal to twist to the left were related to the rumen contractions.

Dr. D. W. Colvard reported that questionnaires had been mailed to county agents, vocational agricultural teachers and to farmers to gather information on about 400 cases of bloat. The material compiled revealed that there had been 121 deaths, that 140 cases of bloat occurred where hay had not been fed before turning cattle on pasture and that 130 cases occurred when hay was fed before turning on pasture. Most of the cases of bloat were in the newer livestock areas. It was also observed that animals died after consuming wilted wild cherry leaves and that bloat followed the ingestion of such leaves.

B. F. Barrentine told of a section in the Delta region of Mississippi where bloat can be produced at will. In tests at State College, Mississippi, with 40 steer calves turned on clover pasture it was observed

that about 1/3 would always bloat, about 1/3 would bloat sometimes and about 1/3 never bloated. These calves were kept in dry lot with no feed during the night and turned on clover in the morning. It was noted that more bloat occurred in the afternoon if the animals had grazed in the morning. It has not been determined whether this is a delayed effect. The differences in location effects will probably lead to a study of the relation of fertility levels to bloat. No mineral mixture so far tried or dry feeds were successful in preventing bloat. It was noted that steers differed from day to day in their preference for different plant materials. Clovers treated with 2-4 D until the plant was almost wilted would still produce bloat. Brahma steers seemed to be more resistant to bloat than steers of other breeds. Survey figures indicated that of 6,000 cases of bloat reported in 1949 there were approximately 600 deaths, and in 1950 8,000 cases were reported and 1,000 deaths.

Dr. A. T. Phillipson raised the question as to whether animals died as a result of gas pressure or does the gas pressure excite some other factor to produce death. No answer.

Dr. H. H. Cole suggested the possibility of adopting a uniform procedure of measuring gas pressure in the rumen through the general use of a pressure manometer described in the Review of Scientific Instruments, Vol. 16. No. 4, 79-81, April 1945. He also pointed out that the functioning of the cardiac opening was controlled by the central nervous system. Also, their results had indicated that the pressure in the rumen was sub-atmospheric.

Dr. Dougherty stated that he was working on the fractionation of plant juices. A protein fraction has been recovered that is not histamine but which might possibly give a histamine reaction on the body.

Prof. Baskett explained briefly the technique used by Ferguson of England. The work is concerned with measuring ileum preparations for potency by determining their effect on the ileum of rabbits.

PHYSIO-PATHOLOGY

Dr. Gall raised the question as to whether bloat was a cause or an effect. She also pointed out that the increased gas pressure could cause an increase in gas absorption.

Dr. Dougherty pointed out that under normal conditions an animal was able to get rid of all gas produced by eructation.

Dr. Nichols found in studies with 12 head of sheep that the ingestion of any kind of fluid would bring about a cessation of belching. The introduction of water or gas alone into the rumen would not produce bloat. In observed cases of bloat it was noted that belching did not cease as soon as symptoms of rumen distention became evident. He found a gas pressure of 1 1/4 lbs. in the rumen in clinical cases. A sudden release of pressure in heavily bloated animals throws the animal into a coma.

Dr. Sampson stated that clinically the relief of gas pressure does aid in bringing comfort to the cow in the case of common bloat. Frothy bloat is not relieved by either a stomach tube or rumen puncture. Under field conditions many animals recover without treatment, or with such "first aid" as tying a stick in the mouth.

Dr. Burrourghs found that the surface tension of the ingesta of chronic bloaters was lower than that of non-bloaters. It has been difficult to produce gas in test tubes from the fermentation of certain types of plant materials. The glucose content of young alfalfa plants was higher as compared to more mature plants. It also appeared to be higher in the afternoon than in the morning. This condition is apparently related to the amount of sunlight for on cloudy days the glucose content does not rise in the afternoon.

Dr. Simms stated that Oregon State had figured that bloat losses had cost $5.00 per acre per year on a 30 acre irrigated pasture. This figure was calculated on losses over a period of years. In this particular pasture ladino clover had gradually crowded out the grasses.

Dr. Boyd pointed out that the stomach tube was the treatement of choice in the hands of the practitioner. The administration of salts is sometimes effective. A gag is a first aid treatment if accompanied by kneading of the rumen. Advances are being made in the use of drugs for treatment of bloat. Removal of animals from pasture or feed will permit most animals to recover.

Dr. Nichols pointed out that pressure influences blood supply and lowered blood supply affects muscular activity.

Dr. Dougherty summed up the discussion by saying it was apparent that not too much is known about the fundamentals of bloat and the cause of death in cases of bloat. Aside from mechanical treatment, knowledge on treatment of bloat was also deficient.

AGRONOMIC

Dr. Kennedy introduced the subject with the statement that bloat had not been a serious problem in New York State. He pointed out the elimination of legumes from the pasture mixture reduced the amount of nitrogen not only in the soil but also in the plant. The fear of bloat appears to be the greatest deterent to a more widespread adoption of the pasture improvement plan.

Dr. Brown felt that the use of legumes is the key to success in pasture improvement. In Missouri annual lespedeza is the most commonly used legume and so far there has been no difficulty with bloat. If the proportion of grass to legume can be kept in proper balance, the trouble experienced with bloat will be minimized. It was reported that two new species of tall fescue are being developed which will probably compete favorably with ladino clover of poor clay soils. He feels that orchard grass will also compete successfully on well drained soils.

Mr. Murphy reported that bloat had probably been more serious in Missouri this year than it had been for many years. It was observed that little bloat trouble was experienced where the proportion of ladino clover to grass was not greater than 50%. Experience has indicated that a fairly heavy application of nitrogen at preparation time enabled the grasses to make a good start and compete well with the clovers.

Dr. Hobbs stated that in Tennessee there was little trouble with bloat until all of the grasses had disappeared. With a fair proportion of grass in the pasture they had had little trouble. They have found that seeding grass in the fall and legume in the spring had made it possible for the grasses to compete with legumes.

Dr. Barrentine found that nitrogen treatement has made it possible to produce pure stands of fescue in plots at Mississippi.

Dr. Beard reported that heavy applications of nitrogen takes the legumes out of a mixture.

Mr. Hein had noted that two crops could be harvested from a newly established stand without any difficulties but at about the time of the third harvest bloat became a problem. This was especially true during the month of June. He called attention to the fact that widely different rates of seeding orchard grass were used in various parts of the country in order to get good stands.

Dr. Phillipson called attention to the fact that bloat does occur in England on strictly grass pastures.

Prof. Baskett stated that rapid growing rye grasses will produce bloat.

Prof. Leveck reported that bloat will occur on any lush clovers in Mississippi.

Dr. Kennedy stated that trefoil production was so small in New York State that generally speaking they had little trouble with bloat.

Mr. Dent indicated that the big trefoil being used in Oregon had not caused bloat to date.

Mr. Sullivan raised the question as to whether the amount of readily fermentable carbohydrates in pasture forage might be a factor in producing bloat. The amount of fermentable carbohydrates available varies with the type of forage. Carbohydrates are higher in grasses than in legumes while the reverse is true in the case of nitrogen. Grazing permits animals to ingest living cells that are still active and to add them to the system already present in the rumen.

Dr. Gail pointed out that bacteria require both sugar and nitrogen for growth. This may be a factor in producing bloat on legumes.

Dr. Barrentine reported that they had had no appreciable trouble with bloat on oat and rye pastures containing from 25-30 percent protein.

Dr. Aamodt stated that rye grass is probably the best grass available to grow with ladino clover for preventing bloat. He also pointed out that while a 10% loss among animals from bloat is serious, it should be remembered that this loss may be more than offset by the gains produced on improved pastures. Improved pastures may increase production of animals as much as 200 percent. Fertilizer treatments influence the type of stand obtained. Heavy applications of phosphates increase the legumes and reduce the grasses.

Dr. Livesay reported that bloat had caused little trouble in West Virginia on their bluegrass-clover pastures. This was true even on the pastures that were well fertilized.

MANAGEMENT

Dr. Cole stated that the water content of the soil, and presumably that of the plant growing on that soil, influences palatability of alfalfa. He pointed out that we have to deal with two types of bloat - chronic and acute bloat. The former condition does not depend upon the nature of the feed ingested. He feels that it would be desirable to differentiate the types of bloat in any discussion. He also pointed out that any condition which interrupts the mechanism of belching will produce bloat. Many cases of death, which have been attributed to bloat, were not actually caused by bloat.

Dr. Miller of Texas reported that there has been no difficulty with bloat where cattle had access to a variety of feeds. However, grazing on pure stands of clover had been accompanied by bloat troubles. Wheat poisoning of cattle had been largely eliminated when the animals had grazing access to other feeds such as hegari, etc.

In using supplemental grasses as a means of bloat control, Dr. Cole pointed out that it was necessary to have these grasses in a palatable condition so that enough is consumed to overcome the effects of the bloat producing feeds.

Dr. Hobbs stated that in Tennessee they were recommending to farmers that mixtures for seeding should contain 50% or more of grasses. When too much legume appears in the pastures then the farmer should seed oats. Water and salt should be available at all times. Additonal pastures of ryegrass where legume stand is heavy is also helpful. In cases where additional seeding is not feasible a portable hay-bunk can be moved into pasture for feeding hay.

Mr. Hein pointed out that certain grasses - timothy, brom grass - cannot compete with ladino clover especially during the summer months. On the other hand, orchard grass will grow during the warm months. Ryegrass is a satisfactory competitive grass until rust hits it. Fescue is a satisfactory cool season grass and while it lives during the summer months it produces but little feeding during that time.

Prof. Leveck recommended a mixture of fescue and ladino for his area and pointed out that fertilizer levels influence the growth of legumes.

Dr. Barrick pointed out that it will be difficult to maintain an even balance of grasses and legumes in pastures because of weather conditions, diseases, etc.

Dr. Cole reported that grazing alfalfa alone will produce bloat in sheep. However, when they grazed alfalfa at night and sudan during the day, or the reverse, there was no evidence of bloat. This system of grazing, however, cut the consumption of alfalfa from 10 to 15%. It was necessary to feed 10 pounds of sudan hay to prevent bloat on alfalfa pasture. Barley straw was ineffective for this purpose as the animals would consume only 5 pounds. Alfalfa hay was of little or no value in preventing bloat when fed to animals grazing alfalfa. Cattle fed the top 3 inches of cut alfalfa bloated but when fed the whole plant no difficulties were encountered.

Dr. Nichols observed that animals receiving an adequate diet could be made to bloat by changing hay.

Dr. Miller stated that prairie hay had been effective in preventing bloat. He also stated that some lines of cattle showed more resistance to bloat in dry lot than other lines. Both Dr. Miller and Dr. Green urged that the matter of apparent inherited resistance to bloat should be taken into account in planning experiments.

MICROBIOLOGY

Dr. Pounden opened this section of the conference with the observation that we need to know what causes bloat in order to determine whether organisms as such are associated directly or indirectly with bloat. He raised the question as to whether some organisms produce toxins that may be in part responsible for bloat. Dutch results indicated that beet pulp was a feed which aided in preventing bloat, both because of its lower sugar content and its mechanical effect. Changes in feed of calves changed the character of the rumen flora. There is evidence that calves tried to balance their feed in order to control the rumen flora. He suggested the possibility of using organisms in test tubes to determine the bloatability of feeds.

Dr. Gall pointed out that the feed ingested was the only known thing that influences the rumen flora. All roughage is processed in the rumen by the organisms present. The pH of the rumen in bloat is lower than under normal conditions. A rapid evolution of gas and an impairment

of the eructation process are necessary to produce severe bloat and these conditions must coincide to produce the condition. It is also probable that a toxin may be involved in this process. Environmental conditions are such that the afternoon would be the most optimum time for bloat as at that time there would be more sugar and more amino acids present in the rumen than at any other time. These factors are ideal for bacterial growth. In order for organisms to produce bloat there must be present (1) the proper kind and proper quantity of bacteria causing rapid fermentation, and (2) enough fermentable material in the rumen for these organisms. If a toxin is a factor in bloat it could be introduced into the rumen with the feed or be metabolized in the rumen.

Bloated steers were found to have a normal rumen flora as far as kinds were concerned but there was a quantative increase in certain organisms, especially one that produced CO_2. This organism is a rapid grower. However, in experimentally bloated steers this organism was not present. Work is being done on a certain proteolytic organism to see if it produces a toxin.

Any work on the microbiology of the rumen prior to the last four or five years is absolete. While bloat is a complex problem certain advances are being made that should aid in solving the causes of bloat.

Dr. Phillipson pointed out that the greedy cows are the ones that bloat. Hay feeding, therefore, may govern the rate of ingestion rather than the amount consumed.

Dr. Cole stated that there is a theory that acute bloat is due to a lack of searifying material in the ration. Rumination in the ox is due to the stimulation of this type of material in the rumen. There is a relation between the amount of rumination and the nature of the food ingested. If an animal is not ruminating on pasture it is apt to bloat. Eructation is also influenced by the nature of the food ingested. Fine grinding, for example, will change a non-bloating feed to a bloating feed. The central nervous system controls the eructive mechanism.

Dr. Nichols stated that rumination can be produced by a rubber glove.

In the opinion of Dr. Dougherty, the eructation and rumination functions are two different mechanisms. Goats gassed with phosgene would bloat on alfalfa hay. There were indications that in these animals there was some interference with the belching mechanism.

In studies in an artificial rumen, Dr. Burroughs found that the following factor had to be present in order to stimulate the proliferation or organisms at a rapid rate - a readily available carbohydrate, a simple form of nitrogen, phosphorus, various iron salts (at a high P level), and unknown substances or factors occuring in young growing plants and molasses. A processed rumen juice was of only temporary value in treating chronic bloaters.

Dr. Gall has been able to grow from 25 to 30 varieties of organisms in the test tubes without rumen juices. These organisms digest the same material in approximately the same time in the artificial rumen as in the true rumen. She has found as many as 10 million aerobic organisms per gram of rumen content after feeding. Aerobic organisms can live but not metabolize at an EH-250.

Dr. Whitehair pointed out that bloat was a characteristic of urea toxicity indicating the relationship between high nitrogen intake and bloat.

Dr. Aamodt suggested that the addition of alfalfa or ladino to a ration may introduce many new organisms into the rumen. It is also possible that the plants may introduce an antibiotic that would influence temporarily the rumen flora. Some of the seasonal effects noted in ability to produce bloat may be due to changes in the microflora of the plants.

Dr. Moore stated that in silage studies it was found that the flora of the material varied greatly, presumably due to what was introduced by the plants used.

On November 28, 1951, the group produced the following suggestions for consideration in developing and planning further research on the various phases of the bloat problem:

PHYSIOLOGY

1. Physical and chemical nature of the food and ingesta
2. Fluid level in the rumen
3. Movement of the ingesta
4. Pressure
   (a) Gas
   (b) Liquid
5. Degree of fill
6. Physiology of eructation (belching) and regurgiation
   (a) Physical
   (b) Toxic
   (c) Nervous
7. Rate and time of ingestation (water and food); Habits of animals and influence of climate
8. Material, rate and place of absorption for digestive tract
9. Effect of the more distant parts of the digestive tract

AGRONOMIC

1. How to maintain legume-grass balance
2. How far can nitrogen replace the legume
3. Effect of different species to prevent bloat, and why
   (a) Chemical fraction
   (b) Physical properties
   (c) Fertility level
   (d) Stage of maturity
   (e) Water balance
4. Feasibility of varying the pasture diet
5. Palatability and what influences it

MICROBIOLOGY

1. Presence of toxin products
   (a) Use of artificial rumen to study organisms found in bloat cases
2. Presence of organisms that associate with bloat
3. Antibiotics
   (a) Plant organisms producing antibiotics
   (b) Antibiotice production in the rumen
   (c) Antibiotic modification of rumen microorganisms
4. Application of bacteriological techniques
   (a) Diagnosis
   (b) Bloat stimulating feeds in rumen

PHYSIO-PATHOLOGY

1. Cause of death in acute bloat
   (a) Intoxication
   (b) Mechanical interference with cardio-vascular mechanisms and with respiration
   (c) Shock
2. Predisposing causes of bloat
   (a) Nutritional status
   (b) Previous rations
   (c) Types of pastures being grazed
   (d) Influence of pathological conditions
   (e) Genetic factors (animal)
   (f) Animal habits

3. Study of disturbed physiological processes of bloated animals
   (a) Comparison with animals that refuse to bloat
   (b) Blood pressure
   (c) Salivary secretion
   (d) Motility of entire digestive tract
   (e) Absorption
   (f) Studies of induced cases of thphenites
4. Relationship to overeating disease
5. Differential diagnosis from other diseases
6. Efficiency of various treatments

MANAGEMENT

1. Influence of water intake
   (a) Intrarumenal temperatures as influenced by temperature of water drunk
2. Influence of two species on the same pasture
3. Type of grazing management
   (a) Intermittent vs. intensity
   (b) Staking of animals
   (c) Intermittent vs. constant grazing
   (d) Supplemental grain and hay-feeding - mineral
4. Climatic - rain, dew, change of temperature, wind
5. Shade
6. Topography of pasture

It was also suggested that consideration be given to a more desirable classification of the kinds and intensitites of bloat than that now commonly used.

The group agreed that another meeting on this problem should be held in approximately two years. The time and place of this meeting were considered satisfactory. It was agreed that the chairmen of the various panels, together with the general chairman, should constitute a committee to plan and call the next meeting.

The meeting adjourned at approximately 1:30 PM, November 28, 1951.