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Journal of RANGE MANAGEMENT

Editorial

The Sixth International Grassland Congress

THE Sixth International Grassland Congress will bring together from all parts of the world the leading scientific and technical experts concerned with grasslands. The Congress, to be held at The Pennsylvania State College, August 17–23, 1952, will give consideration to all phases of grassland agriculture.

Grassland agriculture is one of the most important factors in farming and ranching throughout the world today. The scientific management of range, pasture and hay land is essential for permanency in agriculture. Such management is not only a foundation for a better fed population but offers substantial insurance against soil erosion.

Grassland agriculture is not an end in itself but rather a basis for economical livestock production. With tremendous increases in the population in the United States and throughout the world, greater concern is being directed toward possibilities of shortages of milk, meat, wool, hides and other livestock products. In planning for the future, agricultural leadership must look more and more to grassland agriculture to help insure an economy of abundance here at home and among the countries of the world struggling to insure freedom from want. One solution can be found in more and better grass and in better utilization of that which is available.

Pasture management on cultivated lands envisions the use of grasses and legumes alone or in combination or rotation according to systems of management best suited to each particular piece of land.

The use of fertilizers, manure and lime, where needed, is another essential in good pasture management, especially in humid and irrigated areas. Chemicals are playing an increasing role in weed control.

The 950 million acres of native forage producing lands of the United States, commonly called range, while much less productive acre for acre than cultivated pastures, in the aggregate furnish a material part of the feed requirements of the Nation's livestock. Range furnishes cheap forage in an integrated range-farm

W. R. CHAPLINE

agricultural enterprise. This is indicative of the vast importance to the peoples of the world of such range lands, that cover more than half of the earth's entire land surface. Improved range management offers possibilities for sustained forage and livestock production, greater production per animal or per acre of range (or both), lower costs, and greater profits.

Notwithstanding the high state of development of grassland programs in limited sections of the world, the program as a whole still represents a great undeveloped resource which can be used profitably to increase the production of food while at the same time conserving the basic resource—the soil. The progress thus far has been encouraging, but much yet remains to be done.

Since grasslands are considered to be the most important part of the agricultural economy of most countries, the improvement and better use of grasslands will have a definite effect in building up national economic strength. The United States and other countries have much to gain from an interchange of scientific information on the many aspects of grassland agriculture and the development of better international understanding. Greater exchange of plant materials and techniques will contribute to the improvement and utilization of this great economic resource.

By way of background, five International Grassland Congresses have been held in other countries. The first was in Germany in 1927, the second in Sweden and Denmark in 1930, the third in Switzerland in 1934, the fourth in Great Britain in 1937, and the fifth in the Netherlands in 1949. The International Grassland Congress Association, formed to carry on the work of the Congress from one meeting to another, was disbanded during World War II.

The Sixth Congress is being sponsored by the Government of the United States and the Food and Agriculture Organization of the United Nations. The Departments of State, Agriculture, and Interior, the Mutual Security Agency, the Land-Grant Colleges and Universities, and many societies, associations and other organizations are actively cooperating in the development of plans for the Congress. The Society of Range Management is directly represented by Past-President Dan Fulton on the Advisory Committee. Numerous other members are serving actively on other committees.

Governments of over sixty countries have been invited. It is expected that most will be represented. The Mutual Security Agency and the Technical Cooperation Administration of the State Department (Point IV) are fitting the Congress into plans for training and study of leaders and technicians from many parts of the world.

Approximately 250 scientists, technicians and agricultural leaders of the world have been invited to present papers. Of these, 150 will be outstanding grassland leaders from countries other than the United States.

The Range Program is set up for three sessions: (1) Management of Range Lands; (2) Range Reseeding; and (3) Shrub Encroachment and Noxious Plants on Range Lands. In the Range Reseeding session, two panels have been provided covering (1) Essentials Underlying Selection of Species for Range Reseeding, and (2) Methods and Procedures for Successful Reseeding of Range Lands. On each of these panels will be representatives from some five or six important range countries.

A visit to local points of grassland interest and a farmers' grassland field day are being arranged for during the week at The Pennsylvania State College. Post-Congress tours of representative

parts of the country are being planned for the two weeks immediately following the Congress. Besides three tours for the eastern half of the country, one is being planned to cover the range and related grassland phases of the West.

English, French, and Spanish have been selected as official languages of the Congress.

Grassland agriculture represents one of the greatest potential safeguards of democratic government in the best interests of freedom-loving peoples everywhere. The Sixth International Grassland Congress will be a vital factor in stimulating mutual understanding in this important field.—*W. R. Chapline*, Chief, Division of Range Research, U. S. Forest Service, and Executive Secretary of the Organizing Committee, Sixth International Grassland Congress, Washington, D. C.

GRASS

Grass is the foregiveness of Nature—her constant benediction. Fields trampled with battle, saturated with blood, torn with the ruts of cannon, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grass-grown like rural lines, are obliterated. Forests decay, harvests perish, flowers vanish, but grass is immortal. Beleaguered by the sullen hosts of winter, it withdraws into the impregnable fortress of its subterranean vitality, and emerges upon the first solicitation of spring. Sown by the winds, by wandering birds, propagated by the subtle horticulture of the elements, which are its ministers and servants, it softens the rude outline of the world. Its tenacious fibers hold the earth in its place, and prevent its soluble components from washing into the wasting sea. It invades the solitude of deserts, climbs the inaccessible slopes and forbidding pinnacles of mountains, modifies climates, and determines the history, character, and destiny of nations. Unobtrusive and patient, it has immortal vigor and aggression. Banished from the thoroughfare and the field, it abides its time to return, and when vigilance is relaxed, or the dynasty has perished, it silently resumes the throne from which it has been expelled, but which it never abdicates. It bears no blazonry of bloom to charm the senses with fragrance or splendor, but its homely hue is more enchanting than the lily or the rose. It yields no fruit in earth or air, and yet should its harvest fail for a single year, famine would depopulate the world.—*John James Ingalls*, in Blue Grass.

Mountain Range Management and Improvement in Greece

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(This discussion is a condensation of the author's report written in Athens, Greece, for the Greek Ministry of Agriculture. The report also was used to inform the United States Department of Agriculture on range-management problems in Greece.)

THE total area of Greece is 13 million hectares (a hectare = 2.47 acres). Of this total, 23 per cent consists of plains, valleys, and low rolling land; the rest is mountainous land. Sixty-three percent of the mountain area is owned by the State, 22 percent by private individuals, and 15 percent by communities, monasteries, etc. State-owned and community areas are administered by the Forest Service.

Mountainous agricultural land is mostly composed of steep sloping soils which are undergoing severe sheet and gully erosion. Forage production is poor and unsystematized, there being a shortage of irrigation water. Production undoubtedly could be increased by development of irrigation systems and more efficient water conservation. The average ownership of mountainous farming area is 2.5 to 3.0 hectares.

Forests of Greece cover, at present, about 1.9 million hectares (15.02 percent), although forested land immediately after the National Revolution of 1821 amounted to 40 percent. The reduction is the result of overcutting, uncontrolled grazing, clearing of woodland for farming purposes, and forest fires. The present acreage is below the minimum indispensable for timber production and, especially, for watershed protection and flood control.

Grazing is uncontrolled on 61 percent of the total mountainous area. Except for some alpine and subalpine regions, all other grazing land is being overused in one way or another. Excessive use occurs mostly in the middle mountain zone, where year-long grazing prevails. A large part of the mountain slope area has been denuded of its herbaceous and brushy cover by overgrazing. Accelerated erosion and mudrock flows occur every year.

The Overstocking Factor

The numbers of livestock are out of proportion to the grazing area in the mountainous regions of Greece. The overstocking problem, however, was more acute in pre-war time than it is today since the livestock industry has been seriously damaged by the Occupational forces and more recently by the guerrilla-communists.

Pre-war and post-war numbers of livestock are listed below:

	1935–36	1949–50	PERCENT REDUCTION
Sheep	8,335,000	6,337,000	24.0
Goats	5,127,000	3,269,000	36.2
Cattle	986,000	675,000	31.5
Donkeys	402,000	371,000	7.7
Horses	364,000	232,000	36.3
Mules	183,000	146,000	20.0
Buffalo	64,000	57,000	10.9

Of all this livestock, only sheep and goats are of special importance, as far as the unregulated mountain grazing land is concerned. A few cattle are also grazed on some mountainous areas, but horses, mules, and donkeys are generally kept on domestic pastures or are fed with forage and grain.

Specifically speaking, the prewar goat numbers were far greater than the carrying capacity of the goat pastures. Although the grazing capacity of the several types of goat ranges in Greece has not been estimated, we should not be far off if we estimated a pasture area of 1.0 hectare per animal year. On this basis, a total pasture area of 5,000,000 hectares of brushland should be needed for the total goat number.

There are ranges in Greece, as in all Mediterranean countries, which are suited very well to goat feeding only. Although a detailed land use classification has not yet been carried out in Greece, it could be approximately estimated that an area of 1,500,000 to 2,000,000 hectares is suitable to permanent goat grazing. Since, however, some of the mountain watersheds covered by typical goat grazing vegetation have to be protected, it is apparent that no more than 2,000,000 goats maximum could be served by the above area of brushland.

Much mountain grassland is also being overstocked by sheep. The Greek Forest Service has estimated that sheep pastures on some mountain watersheds, amounting to 460,000 hectares, are being overgrazed to such a degree that the range area per sheep month does not exceed 0.8 stremmas (1 stremma = 0.1 hectare).

The Mountain Range Types

Alpine or Pseudo-Alpine Pastures

Alpine grassland covers a large area above the extreme timber growth line up to the top of the mountains. It is not a real alpine region from a phytogeographical point of view because timber line has been disturbed by the destruction of the forests.

Alpine grasslands are characterized by steep slopes with some intervening narrow valleys. Annual precipitation varies from 30 to 40 inches. They lie at elevations from 5,000 to 8,000 feet. Limestone formations prevail over the larger part of these regions. Much of this grassland has undergone moderate to serious erosion. The top soil of some slopes over limestone formations has been washed off. Rocky ground surfaces predominate, interspersed with patches on which good grass is grown. Despite these conditions, alpine pastures are maintained in a better shape than all other mountain grassland because spring water is insufficient and not suitably located to permit the complete use of these summer pastures.

The effective season of plant growth and, consequently, the period of profitable grazing is 100 to 120 days, i.e., from late May to early October. As a rule, however, premature grazing prevails on much of these pastures.

Range in the Forestry Zones

Below the alpine region the forestry zone covers an area of about 3 million hectares. Beech, fir, black pine, and oak forests occupy about 40 percent of this area. Open woodland—pastures intermingled with forest—occupy about 13 percent, and grassland comprises the remaining 47 percent. Much of this land, now grazed, was originally covered by forests, composed mostly of fir and oak.

Limestone prevails throughout the beech and fir zone. This zone contains extensive areas of steep slopes that formerly were covered by forests, grasses, and other forage plants, but the vegeta-

tion has now been seriously depleted (Fig. 1). Some very good pastures interspersed with the forested area indicate precipitation varies from 25 to 35 inches. The growing period of the forage plants lasts 120 to 160 days.

FIGURE 1. Steeply sloping mountain grassland in northern Greece formerly covered by beech forest. Overcutting, overgrazing, and unfavorable soil conditions have resulted in severe sheet and gully erosion.

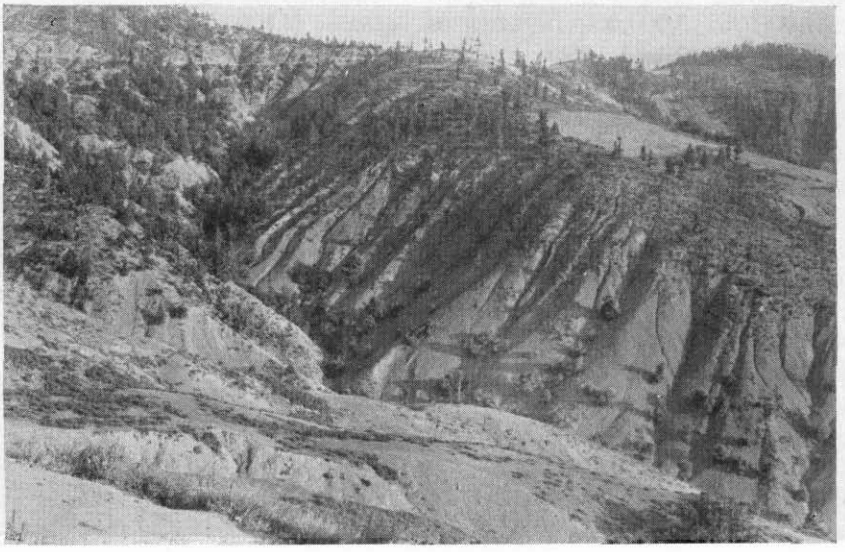

FIGURE 2. Seriously eroded steep slopes in central Greece. Only remnants of deciduous oak forest remain.

the former conditions of the vegetation. Water is generally abundant, but it is unfavorably located. Average annual

Quite different are the geologic, soil, and land use conditions in the zone of the oak forests. Flysch, schist, and crys-

talline metamorphic (gneiss, mica-schists) formations are found there. Overcutting, overgrazing, and very easily eroded geologic formations (Flysch) prevail over a large part of central Greece (Fig. 2). Many villages and, consequently, many farming tracts are interspersed with the forested and range area. Thus, a complicated problem of forestry, range, and farming soil conservation and development is faced in this region. Because of the growth of the population an overpressure is caused on the land. As a result, the oak forests are suffering from grazing, from cutting leafy branches for fodder, and from land clearing for cultivation purposes.

Chalepian Pine and Evergreen Sclerophyl Zone

Total area of this zone is about 5,000,000 hectares, i.e. one-half of the Greek mountainous land. Chalepian pine or the Aleppo pine (*Pinus halepensis*) and chaparral forest occupy only 12 percent of the area. Some 18 percent represents the goat pasture, and 30 percent is depleted brushland used for both sheep and goat grazing. The balance of 40 percent (1,600,000 hectares) is characterized as grassland. Except for the chaparral forested land, which is used for fuel timber production, other chaparral area is composed of typical goat pastures.

Evergreen-sclerophyl formation (chaparral) is composed of many species. Among them evergreen oak (*Quercus coccifera*) predominates on the limestone soils, though *Arbutus* and *Erica* predominate on gneiss, granite, and schist soils.

The chaparral is composed of evergreen tall shrubs, deciduous tall shrubs, and short shrubs. Most desirable among these species are the evergreen oak and *Phillyrea media*. Heavy goat grazing (Fig. 3) has almost caused the disappearance of the legumes: *Coronilla*, *Colutea*, and *Medicago arborea*.

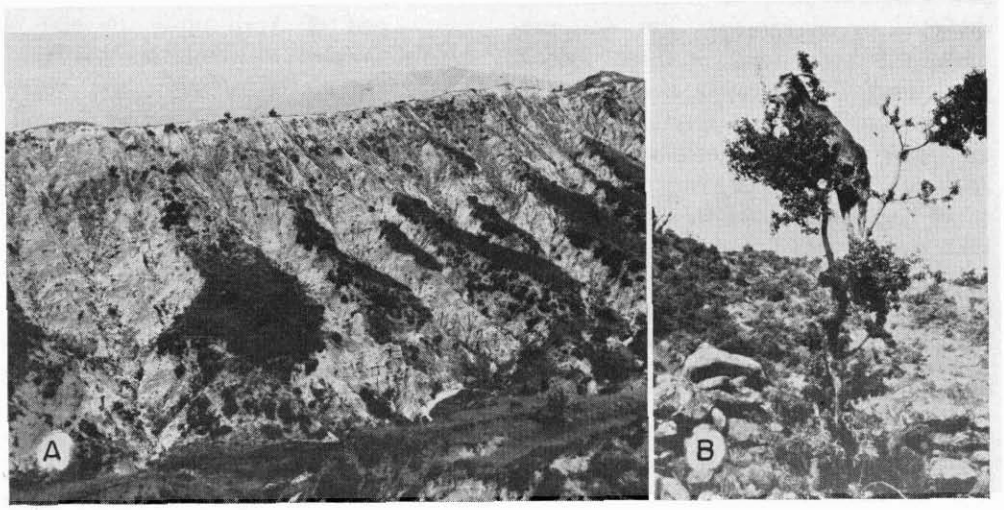

FIGURE 3. RESULTS OF GOAT OVERGRAZING. A. Tremendously gullied slope in northern Greece, formerly covered by evergreen-sclerophyl formation. Depleted by goat overgrazing. B. Goat browsing in top of tree in Greece.

Unlawful brush-range fires occurring every year have destroyed a large acreage of these pastures. Sheep operators used to burn brushland in order to increase or to make more accessible the forage

species used by sheep. Brush fires in the past, having repeatedly occurred on the same region, have caused entire loss of the soil. Rocky surfaces now remain over large areas. This takes place particularly on the summer dry regions made up of limestone. The higher temperature during the fire alters the limestone into something like lime. Thus, root systems are damaged and consequently the sprouting becomes very poor. In addition, sprouts coming from burned plants are usually overgrazed. The result is a gradual disappearance of desirable shrubs and an increase of the less valuable species. Repeated fire, for instance, occurring on chaparral-covered gneiss, schists, and granite soils, where the less desirable species *Arbutus* and *Erica* predominate, cause the disappearance of the evergreen oak.

The grass pastures of the chalepian pine-chaparral zone have been seriously depleted by overgrazing, fire, and premature grazing. Some of these regions, particularly those with southerly exposures on limestone formations, have lost their top soil by erosion extending back over hundreds of years. Herbaceous cover has deteriorated to such a degree that only brushes, weeds, and unpalatable grasses are grown. Approximately some 20 percent of these grasslands have lost 75 percent of their top soil.

Special Aspects of the Range Problem

Range problems in Greece show some peculiarities and complications which make solution difficult.

1. The overlapping lawful rights over the range by the State and the mountain communities results in overstocking of range by lessees, since leases do not specify number of stock or time of grazing. The leases are made for 1 year. The State, however, in order to protect the livestock business, has established a moratorium for both duration and grazing rent. The moratorium is also applied on private range land, resulting in continuous arguments between the lessees and the land owners.
2. Generally speaking, stock breeders have no conception of overstocking. This is also true of some animal husbandry specialists of the country who fail to realize the severe loss incurring every year to the soil resources due to overgrazing.
3. The uneven distribution of livestock ownership. There are in Greece three categories of pastoral livestock business.
   a. The nomad livestock owners, who have no permanent residence and rarely own any lands; their flocks are on the high mountain grazing ranges from about the end of April until the end of October, at which time the flocks are moved down to the winter range on the chaparral (maqui) zone or on some remnant plain pastures. It has been estimated that in the prewar period there were 15,000 nomad families having about 2,500,000 sheep and goats.
   b. The big livestock owners in the village communities having up to 300 sheep and goats. They are entirely dependent upon livestock business and comprise about 10 percent of the mountainous livestock raisers.
   c. The small livestock owners in the villages, having up to 100 sheep or goats and being mainly dependent on agriculture but with supplementary income from livestock.
4. Isolated tracts of farming land,

interspersed, especially with the yearlong ranges, complicate range management. Much range land is also intermingled with the forested area. Special consideration should be given to artificial reseeding of mountainous abandoned farm land, which comprises vast areas on the middle and lower slopes. Artificial reseeding to establish dry pastures will be the best way to improve these areas, since they have been seriously depleted through unsound farming practices and overgrazing.

The Range Management Program

Land Policy Measures

Governmental Land Policy must aim to:

1. Solve the problem of mountainous land use readjustment. This is the most important work to be undertaken. It will be the basis of an integrated, long-term, land reclamation project. This project must comprise agricultural soil conservation and development, the reforestation of an area of about 1,500,000 hectares, and range management.
2. Work out a program of grazing rights regulations, based on sound range management practice.
3. Gradually eliminate goat grazing on commercial forests. Many of the existing goats could be replaced by angora goats or other high yielding stall goats. The introduction of the brown-alpine cattle, which are very suitable for the middle zone of oak and chestnut forest, could be of utmost importance, as far as reducing the number of goats is concerned.
4. Place sheep grazing on the forests under control, by reducing excessive stocking, in order to prevent damage to the forests and to insure sound and permanent sheep grazing on the forests. Attempts must be made to replace sheep by the alpine-brown cattle.
5. Place entirely under protection from grazing some depleted watersheds for erosion and flood control. It has been estimated that mountain watersheds on an area of 2,000,000 hectares must be placed under improvement. Nine projects are being carried out now with E.C.A. funds on the most seriously depleted watersheds of the country—25 percent of this area must be protected from any kind of grazing.
6. Place under administration and management all other mountainous grass and brush pastures.

Legislation providing for elimination of goat grazing from the commercial fir, black pine, beech, and oak forests has been established since 1937. But these drastic measures have not entirely been applied because of the breaking out of World War II and the unfavorable conditions which followed during the Occupation and the recent guerrilla war situations.

Range Management Administration

The Greek Forest Service in cooperation with the Range Management Division of E.C.A. Mission in Greece is planning now the first projects of organizing national forest and grazing districts for range management purposes. The first district is being developed in the Mount Olympus region.

A program of intensive water conservation and development on the mountainous area would create vast opportunities for the establishment of artificial pastures, thus increasing the availabilities of fodder production and insuring considerably higher and better nutrition standards of the animal population.

To the extent possible, fodder produc-

tion should be encouraged in the lowlands.

Such a policy would help in solving the acute problem of overstocking the natural mountain ranges. In this connection the Extension services will be called upon to play an important role by undertaking the big responsibility of disseminating among the mountain villagers and the livestock operators modern methods and practices in fodder production and range management.

An intensive range research program should be applied. Range research will determine the necessary understanding of overgrazing as an important factor of depletion in Greece; it might also help in solving the problem of the management of the watersheds inasmuch as range influences are involved. Of particular interest is research on the best form of management of limestone watersheds, which are mostly covered by typical goat pastures (evergreen sclerophyl formations). Finally, range research should tackle all problems (technical) related to range management and improvement. The experience of the United States Department of Agriculture on range management and improvement will help the Greek Ministry of Agriculture very much in the first steps of their attempt in organizing range management in Greece.

THE ELEVENTH COMMANDMENT

Thou shalt inherit the holy earth as a faithful steward conserving its resources and productivity from generation to generation. Thou shalt safeguard thy fields from soil erosion, thy living waters from drying up, thy forests from desolation, and protect thy hills from overgrazing by the herds, that thy descendants may have abundance forever. If any shall fail in this stewardship of the land, thy fruitful fields shall become sterile stony ground or wasting gullies, and thy descendants shall decrease and live in poverty or perish from off the face of the earth.—*Dr. W. C. Lowdermilk.*

(*"The Eleventh Commandment", written and broadcast over the radio by Dr. Lowdermilk in Jerusalem during June, 1939, was dedicated to the Palestinian Jewish villages whose good stewardship of the earth inspired this idea.*)

Range Management in Israel, Yesterday, Today, and Tomorrow

WAYNE H. MILES

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ISRAEL, land of the Bible, was one of the first countries to ask the Food and Agriculture Organization of the U.N. for assistance in a program of range improvement. It is fitting that this land with its long record as a land of shepherds should now begin a program of range improvement to repair the damage done through centuries of overuse. Long continued and extreme overuse have caused an advanced stage of range deterioration. Most of the soil has disappeared from many of the hills. Where even a shallow layer of soil remains, however, the prospects of improving the range are promising.

Yesterday

We find in the story of Abram and Lot an account of one of the first range wars. "And the land was not able to bear them, that they might dwell together; for their substance was great, so that they could not dwell together. And there was a strife between the herdmen of Abram's cattle and the herdmen of Lot's cattle". Genesis 13:6 and 7. This occurred about 4000 years ago in the area around Beersheba and the southern end of the Dead Sea. This is part of what is now known as the Negev desert.

There was plenty of space so Abraham and Lot agreed to divide the country between them and moved apart. Their herds made them both quite prosperous.

Later the spies sent by Moses to investigate the Promised Land of Israel reported it to be a land that "floweth with milk and honey". (Numbers 13:27). This was a rich and prosperous land.

The frequent references to shepherds in the New Testament indicate that grazing of livestock was a major part of the agriculture of the area in the time of Christ.

Lowdermilk (1944) says that the decline of Palestine's land began during the seventh century A.D. It is quite likely that ranges had been damaged long before this. We know that in recent times range deterioration has been so advanced as to give this area a reputation for desolation and barren hills. The damage was due not only to the grazing of too many stock. It was also due to joint use by a variety of kinds of livestock. There were cattle, donkeys, horses, sheep, goats, and camels. What one class of animals would not eat, another would, and these animals were usually hungry.

Most of the grazing lands were also public lands. A nearby village had nominal use of the adjoining range lands. There was no law, however, to prevent another village from using the same lands. Roving Bedouin, or tent dwelling Arabs, were also free to come in and use the same range (Fig. 1).

Under this system there was little reason for the individual livestock user to try to improve the range. His chief interest was to get the feed before it was used by someone else. Often his very life and that of his family depended on six or eight goats and one or two donkeys.

The only limitations on livestock numbers and on the amount of grazing for centuries have been the natural ones. Half starved animals have a lower rate of

reproduction. There was also the occasional dry year when the shortage of feed resulted in death by starvation for large numbers of range livestock. The cycle of a buildup of stock numbers in average to good years and widespread death losses in poor years seems to have been the accepted system of managing livestock. It is, of course, a system which destroys the range feed plants. Much of this land receives 4 to 40 inches of annual rainfall. Heavy grazing is responsible for giving the appearance of a desert to lands that could be quite productive range lands.

many of the Bedouin herdsmen are now refugees. The lands once used by these refugees for grazing have had little or no use for the past three years.

The change in three years of lighter grazing has been remarkable. Ecologists and botanists are now finding many specimens of palatable plants that in former times were rarely found. There is a wealth of good local perennial grass species well adapted to reseeding. A fine growth of annual legumes capable of restoring some of the fertility lost through centuries of overuse and erosion showed up as soon as grazing was reduced.

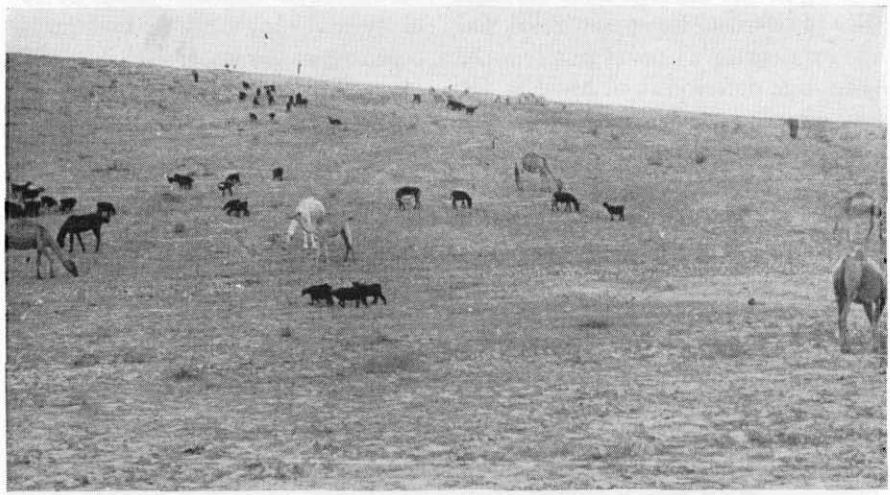

Figure 1. A mixed herd of Bedouin livestock grazing near Beersheba, Israel.

Reifenberg (1947) in "The Soils of Palestine" has estimated that there is a loss of 2 millimeters of soil per year from the hills of Palestine. Extended over the past 1,000 years this would indicate a loss of 6.5 feet of soil. Is it not logical to lay much of Israel's decline to this erosion? To a large extent this erosion is chargeable to overgrazing.

Today

As a result of recent disturbances in Israel, many of the Arab villagers and Trees and shrubs are coming back in many areas to partially hide the rocks that were so prominent when the lands were closely grazed.

In spite of severe drouth in 1951, perennial grasses made a good seed crop. Two years of protection had allowed new grass plants to get started and to build up vigor.

Seed production was seen in northern Israel in 1951, for such good native perennial grasses as Harding grass (*Phalaris tuberosa*), bulbous barley (*Hor-*

deum bulbosum), smilo (*Oryzopsis miliacea*), *O. caerulescens*, *Bromus erectus*, orchard grass (*Dactylis glomerata*) and *Stipa aristella*. Even in the drier climate, 4 to 9 inches annual rainfall, south and east of Beersheba there was seed production of such valuable grasses as *S. fontenasi*, *S. parviflora*, *Aristida cilliare*, *A. plumosa* and smilo.

Research work has already been started at the Government experiment station at Neve Yaar to find adapted species and improved strains of grasses and legumes for reseeding. This work is under the direction of Mr. Aronovitch, Director and Mr. A. Hammelburg, agronomist. Other trials on methods of brush control and seeding of rough lands are under Mr. Z. Nave at the same station. The station has also started research on rates and methods of stocking to determine how to use the crop of range feed. These studies are to find out what amount of grazing may be allowed without damage to the feed plants.

Mr. Alfred Avram, a member of Kibbutz Dalia, started row trials with native plants and with other seeds that he had brought back from a visit to research stations in the U. S. Mr. Avram also made two block plantings of native smilo (Fig. 2) and *O. caerulescens* about five years ago. Clippings from these two plots by the author in May 1951 indicated yields of 3375 pounds per acre and 2935 pounds per acre respectively for these grasses after a rainfall of 16 inches during the previous winter. This area usually gets about 20 inches of annual rainfall.

Figure 2. Reseeded smilo grass on shallow soil near Kibbutz Dalia, Israel. Planted by Alfred Avram five years previously.

Mr. David Schley of the Soil Conservation Experiment Station near Natania in the Coastal Plain also had a number of row trials of various native and introduced species of grasses and legumes.

Mr. N. Gil, Chief, Soil Conservation Service, is an enthusiastic advocate of range improvement who has made hundreds of trial plantings over the past 10 years. Gil is a member of The American Society of Range Management.

Dr. Hugo Boyko, Chief Ecologist of the

Ministry of Agriculture, has made valuable studies (1949) of the various plant communities of Israel. Dr. M. Zohary and his son D. Zohary, Botanists, of the Hebrew University, have also done valuable work in this same field.

This local work has provided valuable information on which to begin a program of range improvement.

Tomorrow

To predict the future of range management in Israel is, of course, a matter of speculation. The following are, however, some indication of the trend that the future may take.

A land capability survey is already under way to map soil characteristics of each parcel of soil and to determine the best longtime use for each of the various soils in the country. The program of range improvement is to be part of a general program of soil conservation.

The establishment and management of a good grass cover should be the basis of the conservation program on lands that are to be grazed.

In most of the range lands north of Beersheba, this program of range improvement should be based on reseeding the author believes. This area gets from 8 to about 40 inches of rainfall. Proper species and methods of seeding must be found to fit local conditions.

Development work is already started on a grass seed nursery of 480 acres near Migdal Ascalon in the Southern Coastal Area. Seed of native grasses and of adapted introduced species is to be grown under irrigation. When completed this nursery should be able to furnish seed for planting 10,000 to 20,000 acres each year. Seed may also be collected from older reseeded fields once the program gets under way.

The range research work which has already been outlined, can and should be continued and increased. Along with research at experiment stations, a program of field reseeding trials is planned. These trial plots are to be large enough to be grazed. The Soil Conservation Service in the 1951–52 season has planned and seeded about 375 acres of perennial grass in eight field trials. Each plot represents a different problem area needing to be reseeded. Trials range from a brush burn area at Matzuba with 32 inches annual rainfall to a water spreader area near Mashavim with less then 4 inches annual rainfall.

A close working relationship should continue between soil conservation operations people and range research workers so that each may be guided by newest developments in the others' program. As an example, most of the eight field trials on reseeding include only grass species. It is hoped that native annual legumes will grow between the grass clumps in good years. The legumes are considered to be necessary for soil building. If they do not occur naturally additional work must be done to find how legumes can be introduced in the mixtures.

When the good grasses and legumes are established on an area they should then be so used as to maintain themselves. The idea that a part of the forage crop should be left on the ground as litter is being encouraged.

A longer season of green forage on the range is needed and should be one of the aims of the seeding program. Bulbous barley and Harding grass make a more rapid early growth than the annual plants following the first winter rains. Smilo, *O. caerulescens* and *Stipa aristella* stay green for as much as a month after the annual plants are gone. The use of different species should, therefore extend the grazing season. This may be done either through mixtures or by seeding separate areas to various single species. The severe summer drouth which is characteristic of the Mediterranean cli-

mate sets limits on what can be accomplished, but two extra months of good green feed seems a reasonable goal.

The summer drouth and intensive farm development will probably lead stockmen to use most of the feed from their improved pastures during the growing season. Sudan grass, irrigated pasture and harvested roughage must be developed to carry through the dry season. Much of the pasture is needed for dairy cattle.

Several problems of a more general nature need to be solved in connection with the range program, some of these are: (1) The need for allotting definite areas for grazing with laws to prevent trespass. (2) A workable method of controlling stock numbers and time of grazing in the individual settlements to which a range allotment is made. (3) Security measures to prevent stealing, so cattle and other livestock can be left unattended in fenced pastures. (4) The consolidation and enlargement of many fragmented farm holdings to allow the economic production of hay, silage, grains, and pasture for supplemental livestock feed. (5) A large segment of the population accustomed to using primitive tools for producing crops and to herding small bands of 3 to 50 head of livestock must learn to use modern farm equipment, fences, and similar improved methods of production.

Summary

Centuries of close grazing have bared the fields of Israel of grass. A cycle of building up stock in good years and of a die-off in bad years has come to be accepted. In Biblical times Israel was a land of milk and honey. Erosion resulting from overgrazing is one reason for the decline.

Today in Israel there are fewer stock. Already the good plants are becoming more common. Perennial grasses made feed and seed in 1951 in spite of severe drouth. Local research has shown some of the adapted species for reseeding.

Israel is making plans to improve her range. A land capability survey will determine the best use of each parcel of land and will show which lands should be in range grass.

Reseeding of perennial grasses is needed for extensive areas of range lands. A grass seed nursery is being established. Eight reseeding trials totalling about 375 acres were made in the 1951–52 season. Proper use of these reseeded lands will be necessary. Selection of the proper species should extend the green grazing period and give higher yields. The need for supplemental feed production for livestock is discussed.

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Fertirrigation Practice in Italy

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A SYSTEM is now in operation in the Italian Alps to obtain maximum pasture production by utilization of the hydraulic resources available at high elevations.

It is well known that the chief limiting factor in pasture development is the inadequate distribution of organic fertilizers represented by liquid and solid animal excreta. This excreta, rich in nitrogen, phosphorus, and potassium as well as in the biochemical principles, phytohormones and auxones, is mostly accumulated near barns or sheep folds, but instead of being spread out to produce rich forage for pasturage of stock and eventually for hay making, it is allowed to accumulate, so that, owing to the excess of humus, it supports only useless nitrophile vegetation.

One attempt to utilize this organic fertilizer was by means of a fertilizer-irrigation scheme, carried out by means of a small stream of water diverted to flow through the stable or barn, flushing out the animal droppings, and distributing them by means of small channels over the slopes below the barns. This method is successful only where the livestock barns are placed at high elevations. Moreover there is the obstacle of uneven flow of water on an irregular topography, and uneven distribution of the fertilizer elements, while percolation may be slower than runoff.

A considerable advance in technique was achieved by Dr. G. Friedmann, whereby water is conveyed by pipes to the stable and the high pressure used to pick up the urine and dung by means of nozzles. The resultant liquid (Italian—Liquame) is collected in a reservoir at any desired dilution.

The solution is fed into a system of permanent underground piping from which it is pumped through a movable or portable piping system of light metal, joined by easily manipulated joints, into the spraying apparatus, which is mostly of the rotating type. From these spray nozzles the mixture is spread onto the pastures in the form of rain. To exclude the solid material, straw, etc., from being fed into the reservoir a machine has been designed to operate by a treadle or motor to free the manure from the straw.

The hydraulic apparatus called a mixer (Italian—miscelatore) which mixes the manure by means of high pressure water (Fig. 1) must be capable of altering the dilution of the liquid fertilizer, and also of increasing pressure so that with small discharges an adequate area can be covered by the jet, and the fertirrigation can be conducted at stable level with maximum discharge and also heavy discharges achieved with greatest range, as much as 200 metres (Fig. 2). If the intake of the system lies higher than the stable or yard a pump is not required, but if the spring is lower an ordinary pressure pump is found satisfactory because the mixing device is placed in the circuit after the pump, which can be a rotary one as it works with clean water.

From an agronomic point of view the system requires adjustment in both the amount of water and the fertilizer content to be used on the pasture according

to the seasonal requirements of the pasture association, and the nature of the pasture rotation.

Irrigation in this way is carried out at five to seven day intervals, calculated to keep the surface horizons of the soil

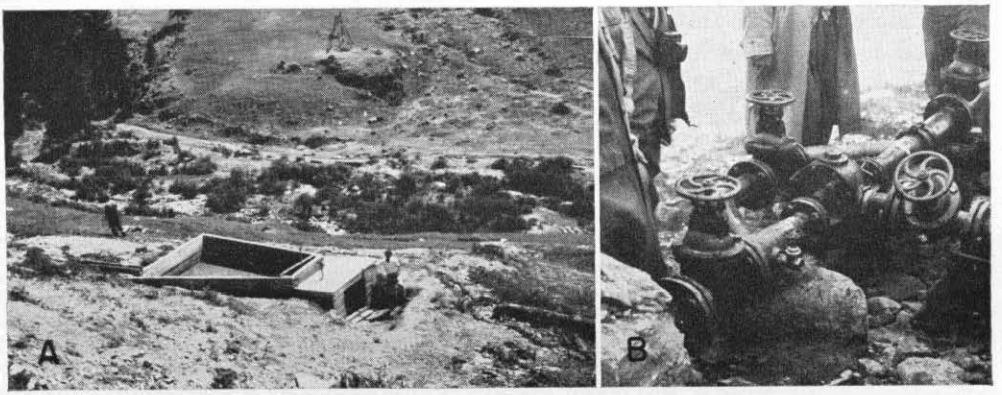

FIGURE 1. FERTIRRIGATION EQUIPMENT. A. Mixer. B. Pressure automan (distributor) system.

FIGURE 2. The fertirrigation system in action on a good mountain pasture.

Normally the lowest dilutions (2 to 5 percent) are preferred, as at these concentrations most of the fertilizer is absorbed, and it comes more easily into contact with the root system. The practice is usually to precede the fertirrigation with a previous irrigation with pure water.

permanently moist, and encourage the maximum production of forage, as well as a thickening of the surface cover of vegetation to guard against erosion. The scheme aims at a progressive improvement in the composition of the pasture, i.e. its qualitative evolution.

It is possible also to combine mineral

fertilizers with the mixture, especially phosphates, by means of a mixing chamber.

Irrigation is indispensable in the dry mountain climates of Italy and without it good forage cannot be obtained. In practice it is found that one hectare of soil regularly irrigated and well fertilized by this system will yield more than several hectares of poor and arid pasture.

The system briefly described here was originally developed in Switzerland where it was established and popularized by Dr. Friedmann, a specialist in this type of practice, who was appointed by the Swiss Government as its adviser on the subject.

Recently in Italy some units for fertirrigation were set up in Aosta Valley (Piedmont) and at Valtellina (Lombardy). It is expected that the practice will spread, and nine units will be established.

The value of the system has been adequately demonstrated and well tested.

BROTHERHOOD

Science and art belong to the whole world, and before them vanish the barriers of nationality.—*Goethe.*

God grant that not only the love of liberty, but a thorough knowledge of the rights of man may pervade all nations of the earth, so that a philosopher may set his foot anywhere on its surface, and say, "This is my country."—*Benjamin Franklin.*

The world is my country, all mankind are my brethren, and to do good is my religion.—*Thomas Paine,* in Rights of Man.

The crest and crowning of all good, Life's final star, is Brotherhood.—*Edwin Markham,* in Brotherhood.

Land Use, Soil Erosion, and Livestock Problems in Ceylon

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ON a map Ceylon is observed as a minute pear-shaped island dangling near the southern tip of India and many persons therefore conclude that its problems must have much in common with those of the larger neighbour. Ceylon is of course much influenced by events in India but the smaller land is strangely different in many ways and has a decided individuality of its own. Instead of the vast stretches of country of an endless sameness, as seen from a rail or air journey across India, the Ceylon scene changes quite appreciably over short distances, largely due to the sudden variations in climate and topography.

The main feature is a central mass of mountains running up to 8000 feet, and with a fringe of plains all around, but occupying a much larger space to the north. Against this mountain mass the two monsoons coming alternately from northeast in the winter and from southwest in the summer, are combed out and made to drop their load of rain. The resultant rainfall distribution makes one third of the island (the high hills and the southwest sector) very wet, with heavy falls during both monsoons. The remaining two thirds, including the whole of the northern lowlands gets only one monsoon. Although the rainfall quantity is still useful (45 to 80 inches of rain annually) its distribution is so bad that little or no cultivation has been attempted in the past apart from irrigated paddy land and the primitive form of unirrigated cropping that goes by the name of *chena*. Essentially chena is the same thing as the shifting cultivation which goes by various names throughout southeastern Asia.

The economy of Ceylon depends almost entirely upon the plantation industries of tea, rubber, and coconut palm products of oil and copra. Each of these is a monocrop with enormous compact blocks of country devoted almost entirely to the one thing, thus leaving little space or encouragement for any sort of livestock farming. A hundred years ago great tracts of hill jungle were cleared and burnt to make room for coffee, mostly on pretty steep slopes. The coffee flourished for a time but was hit in the 1880s with a disease which swept the industry off the map. The survivors tried many alternatives, such as cinchona bark, cinnamon, etc., but there was a longish pause before tea was accepted as the right answer. Today there are approximately 600,000 acres of tea, slightly more of rubber and about a million acres under coconut palm. The cocoa bean comes next with somewhere about 30,000 acres. This is being extended as an underplanting of over-age seedling rubber, now rather a problem crop because the costs of replacement with high-yielding clonal plants is too high to be attractive.

In terms of soil erosion these plantations all have their own problems, with tea having earned an unenviable reputation as the soil waster par excellence. In the early days rubber was clean weeded and the soil which was lost then from rubber land is just nobody's business.

Fortunately in the early 1920s a fashion for leguminous creeping cover crops was taken up widely and in a very short time the erosion menace disappeared so far as rubber is concerned. Where this crop is still "losing the bus" is in the failure of the rubber growers to appreciate the vital necessity for water conservation on their steep slopes and shallow soils. Rubber growing in 140 to 200 inches of rain is almost constantly suffering from shortage of soil moisture, and looks like it, too. Although these ground covers are largely edible fodder, grazing is discouraged by the rubber estates, partly because of the loss of latex through cups being broken down by the animals, partly by the extravagant claims for the death of inquisitive cows who lap up the latex when it is milk-like in consistency, only to find later that they have swallowed an embryo motor tire.

Even in the hills, pasture is a problem, for the natural grasslands are artificially maintained as such by a vicious fire cycle which prevents the true ecological climax of tree growth to come in again. The soil at best is a thin one derived from the gneiss shield, and consists of a coarse gravelly sand with a slight admixture of kaolin clay and mica. Under a forest cover it builds up into a reasonably fertile soil, but under a constant regime of grass fires it gets steadily poorer.

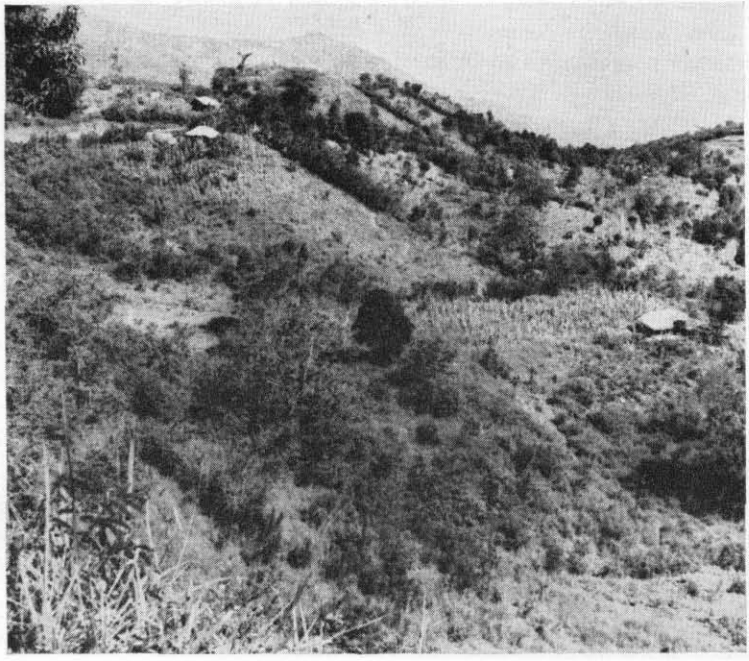

FIGURE 1. Recently established village extension at 3500 feet near Mulhalkelle. Community is already short of water as the water-table is fugitive since the forest cover has been destroyed.

The dominant *Cymbopogons* and *Chrysopogons* give a green bite for a few weeks after they have sprouted but subsequently are useless for grazing until they are again burnt off. No crop such as tea or maize will give much return on this unimproved *patana* soil. The only sure way to make it pay is to build up stored fertility by contour plowing, sow a thick crop of *mana* grass (*Cymbopogon confertifolius*) and keep fire out for 3 or 4 years while a deeper soil is built up.

The average villager is of course not prepared to take this trouble, and so the opening up of newly cleared *patana* land for village extensions (Fig. 1) is apt to degenerate in a very few years to the level of a rural slum.

In the animal husbandry farms in the high hills, there are many interesting problems of cultivation, drainage, soil conservation, and the establishment of sward pastures, but unfortunately the experience gained in them is not applicable to any very large area of land outside their boundaries. The African *kikuyu* grass (*Pennisetum clandestinum*) forms a turf (Fig. 2A) much more readily than any of the local grasses, but so far no legume except *Parochetus communis* has been found to combine with it to make a reasonable sward. The Australian molasses grass (*Melinis minutiflora*) combines with a local legume *Smithia blanda* to make a very palatable and persistent sward (Fig. 2B).

In the lower foothill elevations with better distributed rainfall such as is experienced in the central Experiment Station at Peradeniya (1700 feet and 90 inches of rain) a considerable variety of swards (Fig. 3) have been produced, both in the open and as a carpet under coconut palms. Here the *Paspalums* combine readily with indigenous legumes of the *Indigofera*, *Desmodium*, *Alysicarpus* type of ground cover.

In the arid northern plains, the clearing of forest to make way for new settlements is going ahead fast. Dry farming is not yet established as a dependable technique in the wake of programs which allocate 4 or 5 acres of irrigated paddy rice land and a 3-acre unirrigated block for a house and dry farming or mixed garden crops. Each householder is given two buffaloes and a cow, but so far little plowing is done, although the keeping of plow bullocks is being encouraged. The need for pasture is, however, fairly clear here, and in the true dry farming allotments it is planned as an integral part of the field rotation of 4 years cropping followed by four years under a grass ley. This grass ley is not yet a standard practice, nor is it fully proved that we have

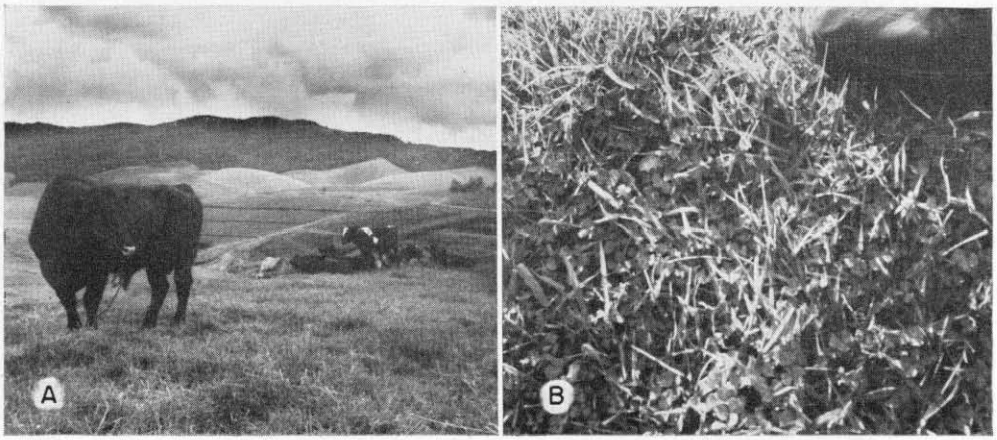

FIGURE 2. SWARD PASTURES, AMBAWELA GOVERNMENT FARM, 6200 FEET. A. Red Poll bull and calves in a *kikuyu* grass pasture. Contour ridges on steep cleared slopes and natural forest along the hill top. B. A cultivated mixture of *Melinis* grass and indigenous legume *Smithia blanda* shows great promise as a pasture mixture.

evolved a grass and legume mixture which will outlast 3 or 4 years of alternate monsoon and drought. So far the best mixture appears to be the *Melinis* with another Australian *Stylosanthes* as the leguminous component. Several of these "Stylos" are being tried, and so far *S. gracilis* has been the most promising. As a cover between field crops, the Bombay cowpea looks like being the mainstay of the crop rotation.

lated hilltop of tea severely mauled by a concentration of buffaloes surreptitiously herded in during one of their off-duty periods of relaxation from "mudding" the paddy fields.

In a well managed tea estate there is of course no room for grazing animals, though most of the Indian Tamil laborers keep stall-fed cows in their lines, and there is a big demand for cut fodder grass. Clean-weeding continues as stand-

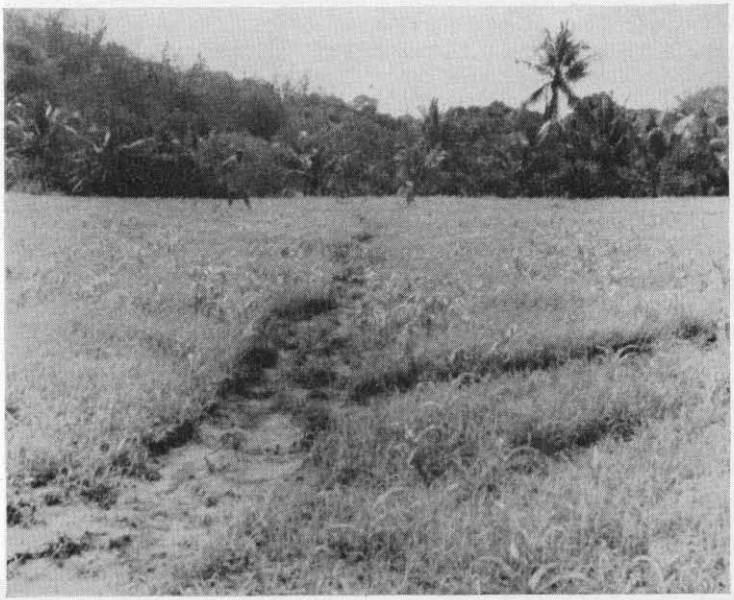

FIGURE 3. Wimera grass sown broadcast on unterraced slopes has taken well except where main drainage of a storm has gullied away the young plants. Mahaberyatenne, an uptodate commercial dairy farm, lower hills at about 1700 feet.

In a land where there are very few sheep or goats, few pigs, and practically no horses, mighty little plowing, and a negligible demand for milk, one might expect to be rid of the spook of overgrazing. Compared with India's 80 million head of scraggy cattle, the Ceylon cattle are a comparatively simple problem, but even here one finds the inevitable sore spots where the neighbours' cattle, often semi-wild, do damage in the coconut estates. Recently I was shown an isoard practice in tea, but current developments favor the retention of low ground cover plants such as *Oxalis*, *Drymaria*, *Hydrocotyle*, etc. The chief defence against soil loss is the network of deep contour trenches with "lock and spill" partitions which delay the run-off and allow the recovery of part at least of the washed soil from the bays in which the water is ponded back. A good cover of well grown tea with these trenches every 20 to 24 feet down the contour has the surface

well mulched with green manure lopped from hedges of leguminous shrubs such as *Crotolaria* and *Tephrosia*, and from wider spaced shade trees such as *Albizzia*, *Grevillea*, and the Australian wattle *Acacias*.

nursery stock of selected transplants, and gives advice upon the management of coconut estates. The grazing problem in the latter is usually confined to tethered animals, but a great deal of uncontrolled grazing takes place, leading to consider-

FIGURE 4. Unterraced planting of tea in a small holding at 4000 feet. Gum plantation, planted by the Forest Department, forms much needed shelterbelt (*Eucalyptus rostrata*, *E. microcorys*, *E. saligna*, *and E. robusta*).

The type of tea that causes most damage to the soil is the small holding with an open scatter of scraggy ill-tended bushes with their roots exposed until they have the form of the old-fashioned piano stool (Fig. 4). Such crops seldom have any contour drains, so that the sheet erosion is terrible, particularly after cleaning of weeds is done with a heavy mattock. Fortunately Government has realized the need for action and is in progress of building up a new extension service of small-holding tea instructors to be attached to the Tea Research Institute. A similar unit is already in existence for helping the rubber small holders with technical advice and a supply of high yielding clonal planting stock. The Coconut Research Institute is also running an extension service which provides

able erosion and water losses in the sandy coastal plains.

Apart from the destructive *chena* or shifting cultivation in the lowland forests and the hill man's equally destructive unterraced cultivation of maize on very steep slopes, the average villager has only one interest as a farmer and that is his rice paddy crop. The best paddy lands have enough irrigation supply for two crops, and the land is prepared by "mudding," or puddling it by walking two or three water buffaloes around till the mud assumes the consistency of a slushy concrete mix. The transplanting of young plants in preference to direct sowing is being encouraged by the agricultural advisory staff, and some attention is paid to using pure line strains. Even so, the yield is lamentably poor.

There is a fetish that irrigation must be continuous throughout the life of the crop until it can be ripened off, so the amount of water wasted is lamentable. Instead of 3.5 to 4 acre-feet as is used in other irrigation countries, the water used here is 14 or even 20 acre-feet per crop. Thus the buffalo is the main plowing unit, and as the unirrigated crops are largely worked on hillsides with a mattock instead of a plow, there is little need for any plow bullocks. The chief use for oxen is in drawing the light country carts, and the average animal is so slightly built that he has a pretty grim struggle, but they are game little beasts.

There is a considerable and new demand for milk in the towns but not yet in the villages, so milk production is not yet a prime necessity as it is in the western countries. The Agricultural Department has several cattle farms, those in the high hills aiming at establishing European breeds as pure herds of Ayrshires, Jerseys, Red Polls, and those in the plains devoted to the Asiatic breeds such as the Indian Scindi, Tarparkar, and Sahiwal. Experience to date shows that even with a reasonably high yielding strain of milker crossed with the local hill type, the so-called "Dutch" or "Cape" cow, the milk yield drops when these animals are kept long in the lower elevations and in the tropical heat and dry spells of the low country. The disappointing milk yield is probably due to the high absolute humidity and the lack of diurnal fall in temperature in the moist lowlands. It seems therefore that the special problem of the milk supply for the larger towns may be to maintain the herds in the high or middle hills and provide special transport for the milk to get it to market in a good condition. Some excellent pioneering has already been done by a few individuals and plantation companies on these lines, in urban dairies where the feeding and management are reasonably good.

INTERNATIONAL COOPERATION

Recent history has shown that the ultimate boundaries of the free world will depend in large part upon land policies. There are few countries which are not faced with major problems of land tenure and national resource development. Through improved transportation and the wide scope of World War II, people of different nationalities have been brought closer together as never before. Exploited people are learning better ways of life. Persons who had no hope of owning land or of obtaining equitable rights to resource use are insisting that aggressive steps be taken to eliminate conditions of peonage. They inherently want a secure right to land—one of the fundamental incentives to increased production and raised living standards.—*Byron C. Denny,* Our Public Lands, April 1952.

Management and Administration of Range Lands in Japan

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(Paper presented at a meeting of the Division of Range Management, Society of American Foresters, Biloxi, Miss., Dec. 14, 1951.)

BEGINNING with the military occupation of Japan in 1945 a Natural Resources Section of the Army was established in General Headquarters. The purpose of this move was to provide a source of advice to the Supreme Commander of Allied Powers and to the Japanese Government on policies and activities pertaining to agriculture, fisheries, forestry, and mining.

From the time of the surrender in 1945 to the signing of the peace treaty in 1951, the Section of Natural Resources conducted a substantial number of studies in these fields. Specialists or consultants were drawn from the ranks of the military and other Government agencies, from academic and research institutions, and from private industry. One such project, under the general direction of the Forestry Division of Natural Resources, dealt with a study of the native grassland areas of Japan (Fig. 1) and was conducted by the writer April through June of 1951. This paper includes some of the highlights of this study.

FIGURE 1. Famous Mt. Fugi. In the foreground is a view of typical native grasslands, known as "genya."

The lack of published material (either Japanese or English) on grazing in Japan made it necessary to obtain most of the

information from on-the-ground investigation. This was done through inspection in company with prefectural, national, city, town and village officials and through discussion with farmers who use the lands being inspected.

Extent of Grasslands

Estimates by the Ministry of Agriculture and Forestry place the uncultivated area of Japan suitable for range use at about seven million acres. An accurate usability survey probably would reduce this estimate, since appreciable areas now classified as usable would be excluded because of steep slopes and unstable soils. Best records obtainable at this time indicate that only about 3.5 million acres of the nation's range lands are now in use. About 20 percent of this (mostly national forest) is owned by the national government—about 80 percent by communities and private individuals.

Livestock Populations

Livestock on the farms, except horses, has been increasing gradually in recent years. The Ministry of Agriculture and Forestry has reported the increases from the 1931–40 average to 1950 to be as follows:

Dairy cattle from 169,000 to 204,000; draft and beef cattle from 1,542,000 to 2,257,000; sheep from 77,000 to 364,000; goats from 129,000 to 418,000. During this period horses decreased from 1,315,000 to 1,076,000.

In Japan the cow or the horse is kept on the farm primarily for draft purposes. Draft animals become beef only after eight years of labor in the fields and forests and after they have served their usefulness for work (Fig. 2). Milk and beef are not items of daily diet in the average Japanese home.

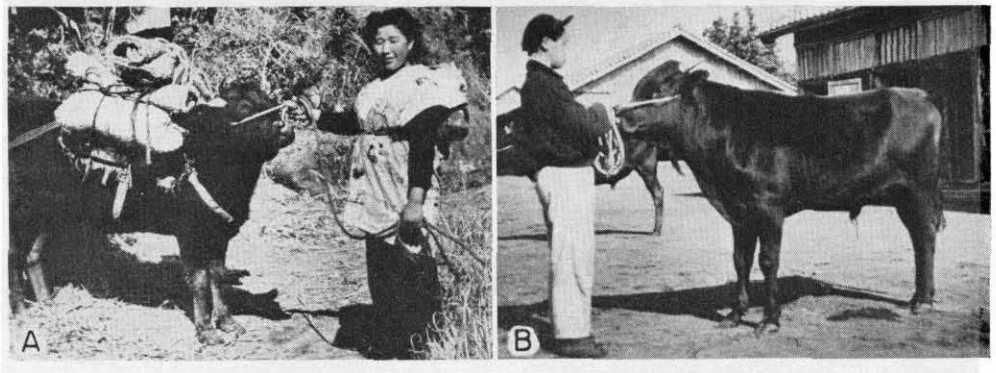

Figure 2. Draft Cattle in Japan. A. Work cow laden with purchases made by the Japanese farm wife in the nearest village. B. Two-year old "bungo" type bull. The breed has been fixed for over 500 years—a small compact animal well adapted to pulling a plow in the rice paddies or carrying a pack over rough mountainous terrain.

Description of the Range

The range itself can be classified into two broad types—one is the nonforested area where grass or grass-like plants predominate, and the other is a mixture of grass, forest, and brush. For Japan as a whole, and considering the area now used for grazing, the mixed type predominates with a ratio of about four to one.

Bamboo grass (*Sasa* spp. and *Pleioblastus* spp.) predominates throughout

the Islands and is strongly dominant in Hokkaido. It is commonly found in open areas but most species will thrive in woodland under 30 to 50 percent shade. The most important feature of bamboo grass is its ability to retain protein and palatability well into the season. It is used both for grazing and hay and, although the leaves and stems are somewhat harsh, possesses a fair degree of palatability. Sometimes this species is used for winter grazing (Fig. 3A), particularly for horses. Other native forage species with the order of importance varying by localities, include:

"Susuki" (*Miscanthus sinensis*) and "kariyasu" (*M. tinctorius*) are distributed widely over nonforested areas and are commonly used for fodder, compost, and thatching. Palatability for grazing use is low except in early stages of growth (Fig. 3B).

"Shiba" (Japanese lawn grass, *Zoysia japonica*) is common in open areas, particularly in Honshu and Kyushu. Palatability is comparatively high throughout the season, and it is easily overgrazed with resulting surface erosion.

"Chi-gaya" (*Imperata cylindrica*) is distributed over all of Japan but is most common in southern Honshu and Kyushu. It is used for grazing but is harsh and unpalatable. It requires a great deal of sunlight and is found in open areas and on dikes and river beds.

"Toda-shiba" (*Arundinella hirta*) is found throughout Japan in both open and wooded areas but is most common in northern Honshu and Kyushu. It loses palatability after early stages of growth.

"O-garukaya" (*Cymbopogon goeringii*) commonly is found in open areas in Honshu and Kyushu. It is used for grazing and is comparatively palatable. "Hagi" (Japanese bush clover, *Lespedeza bicolor*) is the principal leguminous plant on open native ranges. It is used for both grazing and hay and is quite palatable, before maturity, for all kinds of livestock.

All of these species would be listed as coarse grasses. None of them would carry a high rating for either nutrition or palatability, even when used at the height of nutritional development. At the same time most of them are capable of sustaining grazing animals on a maintenance ration throughout the summer season.

FIGURE 3. NATIVE GRASSES. A. Bamboo grass range, northern Honshu, used for winter grazing. Village and Prefectural (State) officials explain the range management plan for this range. B. "Susuki" cut for fodder September 1950 and photographed March 1951.

Use and Management

Native range is subject to two principal types of use: (a) grazing where the animals run at large and (b) cutting for hay or compost where the product is transported from the range to the place of use. Sometimes the same area serves both purposes. Open grazing is practiced most widely in northern Honshu and Hokkaido. Further south the major use of grass land is for cut fodder and compost. Grass is also used for thatching material throughout the islands.

Accurate figures on the area used for grass cutting as opposed to grazing are not available but estimates by the Ministry of Agriculture and Forestry indicate that, exclusive of Hokkaido, about 55 percent of the use of range lands is for cut fodder or compost. In Hokkaido about 15 percent of the area is thus used. Important problems relating to this form of use include transportation from the range to the place of use, drying or curing the product after cutting, and the effect of cutting on future productivity of the grass.

Where grazing is practiced the methods of management compare favorably with those on the best-handled range lands in the United States. More by chance than by design, those who manage the grazing areas show fair adherence to the requirements of proper numbers of livestock, proper seasons of grazing, and proper handling of the livestock on the range. Not much overgrazing occurs because in general the available supply of forage is substantially in excess of the demand for grazing and the range is not readily accessible to the farm holdings.

Most of the grazing lands inspected are managed by village cooperatives, and the individual members are assessed their *pro rata* share for running expenses, including hiring of caretakers, and such maintenance and construction work as limited budgets will allow. This form of management is common throughout Japan where the range is held in communal ownership.

Seasons of use generally are from May to October although some winter grazing is practiced in Hokkaido. In some places, too early use was causing damage to soil and vegetation, but over the country as a whole there appeared to be good compliance with the requirements of proper seasonal use.

Conversion of native grasslands to improved pastures through planting of introduced species would greatly increase the forage value. But how to accomplish this on the relatively remote and inaccessible back-country ranges presents problems for which no immediate solution is available. The land is already covered with a dense growth of grass and shrubs which would have to be removed as a first step in soil preparation. The cost of removal, measured in terms of either heavy equipment or hand labor, would be excessive. Following planting, extremely heavy maintenance would be required to keep out competing vegetation. Information on what, when, where, and how to plant is almost totally lacking. Under prevailing circumstances and conditions, artificial revegetation is not a practical possibility on high native range lands.

A great amount of labor is involved in harvesting and transportation. Cutting is done by hand with a short knife or sickle. The cut grass is transported to the farm house by various methods, including packing by man or beast, or hauling with cart or truck. Where the demand for fodder and compost is heavy the cutting area frequently is located a long distance from the place of use. Several instances were encountered where a day was re-

quired for one round trip to bring out a pack load (200 pounds by horse or cow and 100 pounds by man) of cut fodder.

Only rarely is the cutting area on native grassland close enough to the farm to provide fresh grass for daily use. For this reason most of the fresh-cut fodder during the growing season is obtained from the field and paddy borders, dikes, and small uncultivated corners.

In every case covered by this study, forage cut for winter feeding was harvested long after optimum development. Native grass is relatively low in feed value even when harvested at the most favorable stage of growth. When harvested at or after full maturity, as it is throughout all of Honshu and Kyushu, the resulting product is low in both palatability and nutrition and is barely capable of sustaining animals throughout the winter without supplemental feeding. As practiced now, cutting operations begin in August or September, more than two months after the period of full development.

Range users interviewed gave two reasons for delayed cutting. One is that the proper date of harvesting conflicts with the heavy spring work period on the farms when labor cannot be spared for grass cutting work. The other is that heavy rains and high humidity prevailing in the spring of the year make it impossible to cure cut grass without spoilage from mildew. The latter reason is regarded as the more valid; herein lies the biggest single obstacle to realizing full value from the native forage of Japan. In addition it imposes some very real limitations, not fully recognized by agricultural officials but none the less definite, against future expansion in number of livestock dependent on stored native forage in southern Japan.

Effects of Use

Generally speaking, the present intensity of grazing use on the areas inspected is not having an adverse effect on the soil or forage. Devastation by grazing animals in the sense of destroying all cover and exposing the soil to erosion, a condition found in many parts of the world, does not exist in Japan. Gully erosion as a result of grazing is rare. Three important factors are responsible for this situation. The supply of forage is in excess of the demand; the forage is not attractive because of its low value; and rapid growth of the vegetation, approaching jungle conditions, is effective in healing grazing scars.

On the areas inspected the currently light grazing use is not causing excessive damage to hardwood forests. Full utilization of the forage in such areas would cause damage because grazing and hardwood forestry are not compatible. For this reason range management plans should exclude grazing use of areas where the primary aim is production of hardwood forests. Excessively steep nontimbered slopes, now grazed, should be converted to forests. In tree planting programs where there is local need for grazing, relatively level and accessible areas should be left unplanted.

Range Improvements

The principal improvement structures consist of boundary and compartment fences, access roads and trails, stock watering facilities, association headquarters buildings, shelters for caretakers, and limited amounts of clearing to remove undesirable shrubs which interfere with grasscutting operations. Most of the existing improvements are in a bad state of repair and no longer serve the purpose for which constructed. They were installed in the first place largely

through subsidies granted by the national government and under the pressure of need to provide more horses for military use. When the subsidies were discontinued and the need for increased numbers of horses no longer existed maintenance of the improvements stopped. This is particularly true of boundary and compartment fences.

At least 90 percent of the fences seen consisted of earthen embankments (Fig. 4), generally topped with one or two

FIGURE 4. Newly constructed division fence on a native grassland range in Iwate Prefecture, Japan.

strands of barbed wire. The initial cost of construction is heavy, and deterioration through weathering and erosion is rapid. Without maintenance this type of fence loses its effectiveness five years following construction. Despite its cost, this type of fence is more economical than post and wire construction, especially in southern Japan where post wood material is scarce.

ADMINISTRATION OF RANGE LANDS IN THE NATIONAL FORESTS

On national forests the line of responsibility extends from the Director of the Forestry Agency through the Regional Forester and District Foresters (Forest Supervisors) to the Forest Rangers. Action with respect to use of the range begins with submission of an application from an individual or an association to the District Forester. The application must be accompanied by a "management plan" outlining in some detail the manner in which the forage is to be used and includes such items as number and kinds of livestock, time of grazing, method of handling, and matters pertaining to construction and maintenance of improvements. After receipt of the application the District Forester or his representative (sometimes the Ranger) makes a survey of the area applied for and, if the proposed management plan is satisfactory and the area is less than 12.5 acres, the District Forester may then issue a permit for not to exceed five years. The fee must be paid within 10 days following issuance of the permit. The amount of the fee is linked with the assessed valuation of the land.

If the land applied for exceeds 12.5 acres the District Forester forwards all the papers to the Regional Forester who checks for compliance with general policy and management procedures, and then approves or disapproves issuance of permit by the District Forester.

Range management plans theoretically are prepared as a part of and included in timber management plans put out by the Regional Forester. For this reason the plans cover only broad principles of management and contractual requirements designed to apply to any national forest range area. The detailed prescription for management originates with the applicant.

District Rangers exercise general police powers but have little influence in management or administration of the range. They have been very effective in keeping fire out of national forest range lands.

Range Guidance on Privately Owned Lands

Administrative matters pertaining to the handling of privately owned pasture lands are under the general direction of the Chief of Diversified Farm Section in the Livestock Bureau. Under him is the Chief of Pasture Land Branch who directs the pasture activities of four subsections dealing with specified lines of work.

The personnel of the Pasture Land Branch includes only seven trained pasture specialists, but expansion to 18 is being recommended by the chief of that branch so as to meet the needs for work in the fields of erosion control, livestock feeds, and forestry. The personnel of this branch work in close cooperation with extension and research people in the Agricultural Improvement Bureau.

The foregoing outlines the national government organization responsible for guidance and leadership in the handling of privately owned range lands. At the prefectural level this responsibility is carried by the Chief of the prefectural Livestock Section. Altogether the prefectures now employ about 60 men who specialize in range work. Most of them are not specially trained, but some have had enough experience to qualify as specialists.

Range Research

Range research work on national forests is under the general direction of the Forestry Agency, extending through the Chief of the Forest Experiment Station to such technicians as may be assigned to the Takahagi Experimental Site of the Forest Experiment Station at Uwadai, Ibaraki Prefecture, and to the Sapporo Branch Forest Experiment Station in Hokkaido.

Most of the research work pertaining directly to forage and range problems on privately owned land is under the general direction of the Agricultural Improvement Bureau in the Ministry of Agriculture and Forestry. From this bureau the lines of authority extend through the Research Department, Agricultural Technique Institute, and five agricultural experiment stations to sections, subsections, and laboratories under each covering such activities as general guidance of programs, farm management, livestock, land utilization, pastures, and feed and forage crops.

National and prefectural officials handling both research and administrative pasture work were well informed about the results of experiments with various plants under nursery conditions. At the same time some of them seemed not fully to appreciate the need for more projects of a practical nature. Nursery trials are being conducted to determine the response of various forage plants to reseeding, but little or no work has been done to extend these trials to field conditions. On most range inspected the local officials were proposing to improve the range through introduction of new species but had no information concerning the likelihood of success of such programs.

Lack of finances prohibits adequate staffing in most lines of research work, and such funds as are available usually are allotted to projects other than range. At the Hokkaido Agricultural Experiment Station, for example, of 21 scheduled projects (most of them in the planning stage only) only three dealt with range and pasture problems. One (laboratory only) covered nutritive value of wild

grasses, one covered pasture management, and the third dealt with improvement and utilization of range. Out of 37 technicians and technical assistants, only four had any connection with range projects. The five agricultural experiment stations carry only three pasture specialists. Planned range and pasture experiments at Takahagi Branch Forest Experiment Station are making little headway because of lack of funds. Among experiments planned are such projects as cultivation of lespedeza, development of woodland pasture, testing various species of shelter trees, effect of thinning tree growth on grass production, and demonstration plots of forage plants.

From the brief contacts made, together with information supplied by national and prefectural officials, it appeared that forage and range research had not made much progress in Japan.

Grazing Legislation

In 1950 the Diet enacted a new pasture law, the purpose of which, as outlined in Chapter 1 of the law, was to obtain conservation of pasture land through protection, development, and proper management. It abolishes an earlier law enacted in 1931. It also dissolves all pasture land associations and cooperatives organized under the old law and provides for organization of new ones under a specific ordinance governing such organizations.

The new law applies to all range lands not in national ownership. Chapter 2 outlines the procedures under which pasture owners may apply for and receive technical guidance and financial assistance in improved pasture management. Chapter 3 carries provisions for enforcement of rules designed to stop destructive use of land or forage.

Application for recognition under the law is strictly voluntary. Responsibility for development of management features rests with the owner of the land who submits his proposed plan of management along with the application for recognition. In the case of prefectural lands the proposed regulations are approved or disapproved by the Minister of Agriculture and Forestry; in the case of communally owned lands approval action is by the governor of the prefecture. Only the governor of the prefecture can take direct action under Chapter 3 to stop destructive use.

The new law has not been in effect long enough to test its value or to enable results to be judged. Basically it is a good law because it provides for protection and development of an important part of Japan's range lands. In addition it contains both a statement of purpose and expression of policy. It assigns administrative authority to the prefecture and the national government, subject to ministerial ordinance, for carrying out the purposes of the law. In these respects Japan's pasture legislation is far ahead of that of most other countries.

The weaknesses of the law lie in the fact that: (a) responsibility for initiating proper management rests wholly with the owner of the land; (b) prefectural governors exercise a disproportionate amount of authority in passing on the adequacy of proposal regulations; and (c) the central government cannot initiate direct action under Chapter 3 to stop destructive use.

Under the provisions of the present law covering national forests, the Forestry Agency in the Ministry of Agriculture and Forestry has full authority and responsibility for protection, development, and administration of forage-producing land in the national forests.

Under the provisions of legislation known as the "Owner-Farmer Established Law," national forest land which is used primarily for pasture and which

has a tree cover of less than 30 percent is classified as pasture land and subject to transfer to farmers. If the land is used primarily for reforestation it is classified as forest land and is not subject to transfer. Such transfers, after joint survey and agreement between the Forestry Agency and prefectures are now being made.

Role of Grass in Preventing Floods and Erosion

Any summary of the range land situation in Japan would be incomplete without special emphasis on the value of native grasses in helping to prevent floods and erosion. Their function in this field far exceeds that of producing forage for livestock or compost for paddies. Therefore it behooves the Japanese people to see to it that native grass lands are protected always against deterioration. If they succeed in this they will have accomplished more than many other nations, including the United States.

ONE WORLD

All the trends of our day are toward the unification of our world, whether we like it or not. We are already one world economically. We are one in a physical sense, considering the speed of travel and communication. But unfortunately the world is divided into a thousand parts, and particularly into two great parts, intellectually and morally. That is the essence of our modern problem. It is a new kind of problem. But it is perfectly soluble. It is time for all free nations to agree on a program for peace, and to cooperate whole-heartedly and unselfishly in the achievement of that program.—*Milton S. Eisenhower*, Agronomy Journal, December 1951.

Grazing Land Problems, Molokai Island, Territory of Hawaii

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Introduction

RANGE cattle production is the second largest industry on Molokai Island in Hawaii. Ranchers who run cattle on the grazing lands of the island have many of the same problems that occur on the western ranges of the United States. On the lowlands of the island poor rainfall distribution and high winds are factors limiting forage production. In the highlands, aggressive, unpalatable brush species constitute a major problem in grassland management.

Within a distance of a few miles rainfall often varies from less than 15 inches to over 150 inches per year. Four to five plant zones often occur at levels within a short distance, each with its distinctive plant community.

Lack of effective absorption of rainfall by the soil on the grazing lands is a critical factor today. Good range management, which includes reseeding and sound conservation measures is demonstrating, although somewhat slowly, that a more effective use of the rain can be realized.

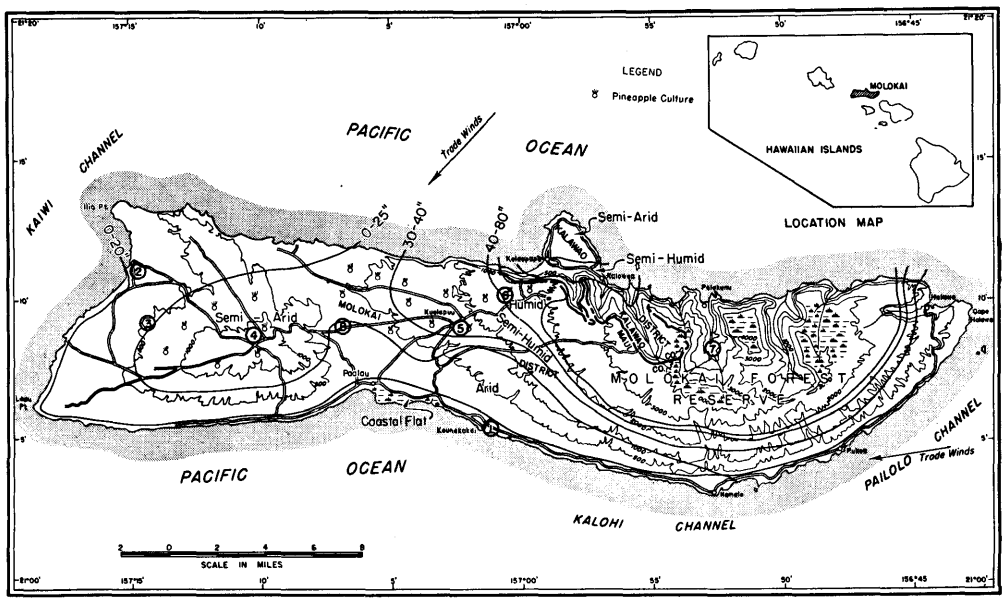

FIGURE 1. ISLAND OF MOLOKAI, HAWAII, SHOWING WEATHER STATIONS, AND RAINFALL AND VEGETATION ZONES

Location

Molokai Island lies about 21° north of the equator, in the same latitude as Cuba. It is one of the smaller islands of the Hawaiian group, covering about 264 square miles (Fig. 1). It is about 7 miles

[1] At present with the U. S. Army.

wide and 36 miles long. The main axis lies approximately due east and west. The highest point, Kamakau Peak, is a little under 5000 feet. The greater part of the land lies between sea level and the 1000 foot contour.

Geology and Soils

Molokai, like the other Hawaiian Islands, is of volcanic origin—the periods of volcanic activity in past ages have occurred over wide intervals. Results of three of these periods can be identified by two major outpourings followed by a lesser one. Geologically speaking, West Molokai, the low part of the island, was formed first. This area has now eroded down to elevations of less than 1300 feet. The next volcanic activity formed what is now known as East Molokai, which has eroded down to an elevation less than 5000 feet. The northeast side of the island is bounded by precipitous cliffs, dissected by a number of steep, short, narrow valleys. The southerly slopes, long and uniform, are cut by many deep, steep-sided gulches.

Following the ancient periods of volcanic activity and subsequent senescence, the plains, locally called Hoolehua, were formed by erosion of the higher lands and by the raising of the mid-section of the island from the sea. The third volcanic episode was a comparatively small one. It formed a 2500-acre peninsula in the sea below the steep cliffs of the north side of Molokai Island proper. This peninsula is the site of the leper settlement (Carlson, 1951). It is virtually isolated from the rest of the island by cliffs 1600 to 2000 feet high.

The ashy and basaltic soils vary considerably in texture and depth, most of them are typically red in color. These soils show little or no profile development. Along the west and lee coastline are alluvial flats, which are underlain with brackish water. Above the alluvial soils, north and east towards the highlands, the soils vary from shallow to deep and are often rocky. In the center of the island and towards the eastern mountains, the soils are deeper red in color and typically show little profile development. The highest elevations have shallow soils with a low pH and a high organic content.

Weather

Although there are two major rainfall patterns during each 12-month period, precipitation varies greatly within a short distance. There is a wide variation between total precipitation from year to year. Table 1 shows the average and the wide variation in yearly totals from the driest (low) to the wettest (high) year on record.

TABLE 1

Yearly rainfall in inches at weather stations, from U. S. Weather Bureau data (15–45 yrs.)

	STATION*					
	1	2	3	4	5	6
Low	3.31	6.16	5.22	12.63	15.44	32.07
Av.	11.70	13.24	23.83	26.75	32.52	45.29
High	23.50	24.20	31.49	40.58	59.32	74.88

* Station 7 had an average of 93 inches.

The kona storms, of which the Hawaiians speak, are major storms that come in from the south and often drop huge volumes of rain. They occur once or twice a year and may drop 8 to 10 inches of rain within a few days. These storms are island-wide, and normally occur between October and April. The violence of the kona storm is indicated by the phenomena of the ocean surrounding two-thirds of the island being colored red for a considerable distance out from shore as a result of the soil washed to sea by each heavy rain.

The trade-wind rains are more local in character, and occur through the year. They come in from the northeast and drop most of their moisture in the northerly windward highlands, seldom on the southern or lee side of the island. The greater part of the yearly rainfall in the highlands is from the trade-wind rainstorms.

A third type of rainstorm is the naulu, which is similar to the thunderstorms of the Great Plains in the States. A naulu of cloudburst proportions can occur at any season. It appears to have no pattern and falls erratically as to locality, time, and volume.

The trade winds, often of high intensity and of yearlong duration, dissipate much of the effectiveness of light rains, which they sometimes bring in. From data compiled from the U. S. Weather Bureau, the main percentage frequency of surface winds at Station 8 (Fig. 1) was as follows: trade winds (northeast to east) from 4 to 12 miles per hour occurred 20.8 percent of the time; and from 13 to 24 miles per hour occurred 44.4 percent of the time. Characteristically, these winds continue following precipitation and dry the surface soil rapidly. The green plants, under heavy winds after the rains, turn brown rapidly thus indicating a too rapid transpiration loss and a depletion of available soil moisture.

Yearly temperatures average about 72° F. From data compiled from the U. S. Weather Bureau, the seasonal variations in mean monthly temperature in Fahrenheit degrees, at Station 4 (Fig. 1) were as follows:

Jan.	Feb.	Mar.	Apr.	May	June
68.6°	68.6°	69.3°	69.4°	71.4°	73.7°
July	Aug.	Sept.	Oct.	Nov.	Dec.
74.2°	75.2°	74.6°	73.7°	71.2°	70.3°

The mean annual temperature was 71.7° F.

Slight seasonal variations have relatively little effect on plant growth.

Vegetation

Vegetation, as might be expected, is markedly influenced by the rainfall pattern and exposure to the prevailing winds (Ripperton and Hosaka, 1942.) Elevation, except as it affects rain, evaporation and wind, appears to have little effect on either kind or volume of vegetation.

Land Use

Agriculture is by far the island's major industry. The major income is from pineapple production on about 18,000 acres of the best lands that lie in the 25- to 50-inch rainfall zone. These lands extend from about the center of the island to within three miles of the west shore. There are also a few small vegetable, taro, and fruit growing farms, totalling about 500 acres.

A sizeable, but secondary source of income, is from livestock. The island has about 115,000 acres of grazing land. In addition about 35,000 acres of protected watershed have been set aside from which cattle are excluded.

History of Grazing Use

Prior to the discovery of the islands by Capt. Cook in 1778, the only herbivorous animal was the pig. The pig was brought to the islands many centuries ago by the Hawaiians. The pig is a limited herbivorous animal and it can be said that the island vegetation would be untouched by grazing animals. In 1853 it is reported that there were 200 head of cattle in Molokai. From that time, cattle and the sheep, goats and horses brought in increased steadily up to 1910. Since 1910 there has been a gradual decrease in livestock numbers.

Unregulated, season-long grazing by

larger and larger numbers of livestock after they were introduced, rapidly changed the aspect and composition of the plant cover. Today, many of the more palatable native and introduced forage plants have been replaced by less palatable species. The vegetation of the grazing lands is now very different from the original cover.

The first cattle introduced were long-horns. With the long-horns came many of the ills that often beset the herdsman the world around. An interesting story is told of cattle rustling in 1857, at the village of Palaau (Cooke, 1949). The overseer for King Kamehameha V, about the mid-century, noted the lessening numbers of stock at Palaau and upon investigation found that the whole community was in the cattle rustling business. The rustlers were apprehended, convicted, and sentenced to five years in jail on the nearby island of Oahu. The women and children of the convicted rustlers chose to accompany them, with the result that the Palaau settlement was deserted.

The long-horns were later replaced by purebred Devons, which in turn were replaced by Herefords. Present indications are that these may be supplanted by the "Braford," a mixture of Brahma and Hereford. Hides, tallow, and wool were the first livestock products sold. Today, with refrigeration, the production of high quality meat is the principal source of income.

In 1907 the Molokai Ranch, Kaunakakai, sheared 17,000 sheep. At present there are probably less than 100 sheep on the island. Goats, too, were released in early days and denuded great areas on Molokai. There are only a few half-wild goats left at this time. Deer were released and they now number over 1000, and range in the kiawe-covered, dry zones of the west end of the island.

The first livestock were allowed to roam at will and under the peculiar customs of the day, slaughtering was not permitted under pain of death. Under these circumstances, as might have been expected, numbers increased far beyond the grazing capacity of the range. Trees died out, streams dried up, range forage became scanty and of poor quality, and erosion reached severe proportions on extensive areas of the island. About 1910 the seriousness of these conditions was recognized and stock numbers have since been reduced, but, unfortunately, not fast enough to stop the downward trend of the rapidly declining range. New forage and cover plants have been introduced, but these have not spread rapidly under continued grazing and the aggressive competition of non-palatable plants. Erosion is still a major problem over extensive areas.

Range Sites

Five distinct range types, based on rainfall zones (Fig. 1), have been recognized in the range conservation work.

RANGE SITE	RAINFALL	PREDOMINANT VEGETATION
1. Coastal flat...	0–20″	Kiawe
2. Arid.....	0–25″	Kiawe-Grassland
3. Semi-arid.....	20–35″	Lantana
4. Semi-humid...	30–40″	Guava
5. Humid.....	40–80″	Guava-Ohia-Fern

Each zone has an identifiable flora (Table 2) with particular grazing requirements for proper use.

Coastal flat

The coastal flats are narrow strips of relatively flat land between the ocean and the toe of the hills. There are about 3500 acres of these lands.

An interesting zonation of vegetation is found along the outer fringes of the coastal flats where mangrove covers the

TABLE 2

List of more important range and pasture plants of Molokai Island, showing relative forage value, origin, and zone of importance

SCIENTIFIC NAME	LOCAL OR COMMON NAME	RELATIVE VALUE	ORIGIN	COASTAL FLAT	ARID	SEMI-ARID	SEMI-HUMID	HUMID
			Grasses					
Andropogon barbinodis	fuzzytop	Good	Introd.		X	0		
Andropogon pertusus	beardgrass, pitted	Fair	Introd.		0	X		
Axonopus affinis	carpet grass	Fair	Introd.			0	0	X
Cenchrus echinatus	sandbur	Fair	Introd.	0	X	X		
Chloris gayana	rhodes grass	Good	Introd.	0		X		
Chloris inflata	fingergrass, swollen	Poor	Introd.	0	X			
Chloris virgata	fingergrass, feather	Good	Introd.	0	X	X		
Chrysopogon aciculatus	pilipiliula	Poor	Native			0	X	
Cymbopogon refractus	barbwire grass	Pest	Introd.			0	X	
Cynodon dactylon	Bermuda grass, giant	Good	Introd.		0	X	0	
Digitaria pruriens	kukaipuaa	Good	Introd.			0	X	0
Eleusine indica	wire grass	Poor	Introd.	0	0	X	0	
Eragrostis amabilis	hakonokono	Fair	Native	0	X			
Heteropogon contortus	pili grass	Fair	Native		X	0		
Melinis minutiflora	molasses grass	Good	Introd.		0	X	X	
Panicum maximum	guinea grass	Excellent	Introd.	0	0	X	0	
Panicum torridum	kakonakona	Fair	Native	X	X	0		
Paspalum conjugatum	hilo grass	Fair	Introd.				0	X
Paspalum dilatatum	paspalum; Dallisgrass	Excellent	Introd.			0	X	0
Pennisetum ciliare	African foxtail	Fair	Introd.	0	X	0		
Pennisetum clandestinum	kikuyu grass	Good	Introd.			0	X	0
Setaria geniculata	foxtail, yellow	Poor	Introd.			0	X	0
Setaria verticillata	foxtail, bristly	Poor	Introd.	X	0			
Sporobolus capensis	rattail grass	Fair	Introd.			X	X	
Trichachne insularis	sour grass	Pest	Introd.		0	X	0	
Tricholaena repens	redtop, Natal	Fair	Introd.		0	X	0	
			Shrubs and broad leaved herbs					
Acacia farnesiana	klu	Pest	Introd.			X		
Amaranthus spinosus	amaranth, spiny	Pest	Introd.	0	0	0	X	
Atriplex semibaccata	saltbush, Australia	Fair	Introd.	X	X			
Batis maritima	beach akulikuli	Pest	Introd.	X				
Bidens pilosa	pilipili	Good	Introd.	0	0	X	X	
Cassia leschenaultiana	Jap tea; partridge tea	Poor	Introd.			X	X	
Crotalaria incana	rattle pod, fuzzy	Poor	Introd.		0	X	0	
Desmanthus virgatus	desmanthus	Fair	Introd.			X		
Desmodium uncinatum	clover, Spanish	Excellent	Introd.		0	X	0	
Emex spinosa	emex	Pest	Introd.	0	0	X		
Emilia sonchifolia	pualele, red	Fair	Introd.	0	0	X	X	
Eupatorium adenophorum	pamakani	Pest	Introd.				X	X
Indigofera suffruticosa	indigo	Poor	Introd.		X	X		
Lantana camara	lantana	Pest	Introd.		0	X	0	
Leucaena glauca	koa haole	Excellent	Introd.	X	X	0		
Medicago hispida	bur clover	Good	Introd.	0	X	X	X	
Metrosideros collina	ohia lehua	Tree	Native				0	X
Phaseolus lathyroides	pea bean, wild	Fair	Introd.			X	0	
Plantago major	laukahi	Poor	Introd.			X	X	
Prosopis chilensis	algoroba, kiawe	Fair	Introd.	X	X			
Psidium guajava	guava	Pest	Introd.			0	X	0
Schinus terebinthifolia	christmas berry	Pest	Introd.				X	
Sida fallax	ilima	Fair	Native	0	X	0		
Waltheria indica	uhaloa	Poor	Introd.	0	X	0		
Xanthium saccharatum	cocklebur	Pest	Introd.	0	0	X		

X—Plants plentiful, growing in communities or clumps
0—Scattered, not growing in communities

wettest areas, and a saltwort, (*Batis maritima*) grows on the drier, salty soils. Inland, the vegetation consists of kiawe (*Prosopis chilensis*) and annual grasses and weeds.

The annual rainfall in these coastal

areas is usually under 20 inches. This may fall in one or two kona storms.

Fertile topsoil, eroded from the higher slopes, has been deposited to depths up to six feet on some of these flats. In a few pockets the soil is highly colloidal and holds water so tightly that very little moisture is available to plants for more than a few weeks after the heavy rains. A few localized areas on the flats are rocky.

On the better drained soils of the coastal flats, even when close to the sea, the kiawe often is impenetrable and of tree size. Kiawe (mesquite to a Texan, or algaroba to a South American) was introduced on the coastal flats of the islands about 125 years ago (Wilcox, 1910). It has now spread from the coastal flats across the island to the uplands. Kiawe stands are so dense on the better soils that few competing plants can grow beneath them. Where the stand of kiawe is open, understory plants grow only after each kona storm. These include such annuals as bristly foxtail (*Setaria verticillata*), swollen finger grass (*Chloris inflata*) and kakonakona (*Panicum torridum*). A few perennials also grow where the shade is not dense and there is sufficient soil moisture. The most important are ilima (*Sida fallax*) and saltbush (*Atriplex semibaccata*). These perennials remain green a little longer than the annuals. Except for scattered clumps of guinea grass (*Panicum maximum*), that sends its roots down to ground water, the rest of the vegetation under the kiawe is made up of coarse, relatively unpalatable weeds. Cattle will graze the understory vegetation lightly, at the season of the year when they are eating the ripening kiawe beans.

Uncrowded kiawe trees produce an abundance of long pods, well filled with beans, which are eaten by the cattle from early July until the first kona storms in October or November. Under present conditions, aside from the dry, understory vegetation, the kiawe pods and beans are the only feed available to the cattle during the late summer and early fall. On this diet, cattle often develop a sickness which affects the nerves and stomach. Once affected, the loss of flesh is rapid and many cattle die. If green grass is supplied, even for only a portion of each day, losses can be avoided through the latter part of the period when the animals are subsisting on kiawe beans.

The coastal flats, when not too saline, will produce some green grass and hardy legumes. This has been demonstrated on the small neighboring island, Lanai, where strips of kiawe have been cleared and planted to guinea grass and a fairly palatable shrub legume, koa haole (*Leucaena glauca*). Satisfactory stands of grass can be maintained if properly irrigated until established and then grazed properly. Sickness due to kiawe bean diet has been markedly reduced on Lanai island by supplying some grass and legume pasture during the "bean" season.

One hundred acres have been cleared of kiawe at the Molokai Ranch, and a sprinkler irrigation system has been installed. Rhodes grass (*Chloris gayana*), and hairy peruvian alfalfa furnish satisfactory pasture. This indicates that where sufficient fair quality water is applied to secure continuous growth, pastures can be established under the prevailing semitropical yearlong temperature. These pastures carry from two to two and one-half head per acre yearlong. The cost of installing irrigated pastures is high, but so are the returns.

Molokai ranchers believe that much of the coastal flat area which is not too salty and where water is available will eventually be cleared for irrigated pasture. Where irrigation water is not available, these ranchers plan to use machinery to open up the thick kiawe stand to permit seedings of dryland perennial grasses.

A number of forage plants in a small grass nursery located on the lee shore in the kiawe area are now under observation. Hopes are held that some adapted perennial dryland species may be discovered which will grow under and between the kiawe trees on the lands where irrigation is not possible.

Arid zone

The arid zone, lying just inland from the coastal flats, is characterized by a sparse to a heavy stand of shrubby to tree size kiawe with an understory of pili grass (*Heteropogon contortus*), annual grasses and shrubby weeds (Egler, 1947). In these grassland ranges, kiawe, the invader, often grows so vigorously that dense thickets have become established—so dense that all competing vegetation is smothered. For the short, winter, green period, ten acres of this poor range are required to support a cow for a month. However, on the better soils, where kiawe trees are in scattered stands, the understory consists of pili grass, annual swollen finger grass, kakonakona, ilima, and uhaloa (*Waltheria indica*).

Some kiawe occurs even on range in excellent condition, but the trees are large and scattered (Fig. 2A). Here the understory annual grasses give way to the shallow-rooted perennial, pili grass, and deeper-rooted fuzzytop (*Andropogon barbinodes*). Rattlepod (*Crotalaria incana*) and Jap tea (*Cassia leschenaultiana*), both legumes, grow intermingled with the grasses, but are relatively unpalatable. The yield of grazable forage on the deeper soils is high. One to two acres of this range in excellent condition will feed a mature cow for a month and still leave sufficient residue to control erosion.

This zone receives less than 25 inches of rain, much of which may fall within two weeks. The prevailing trade winds strike continuously, adding further to the aridity of these lands. Grass stems and tree growth show affects of these winds (Fig. 2A).

The soils of part of this zone are fertile and generally deep. Many acres, however, are severely eroded. The deeper soils would grow adapted cultivated crops if the precipitation was more dependable. The best condition range now is found only on the steep, rocky lands that are more or less inaccessible to livestock.

Customarily, cattle graze these ranges yearlong even though the forage is green only three to six months. The length of the green period depends on the distribution of rainfall. Due to continued, heavy grazing in the past, most of the species now found are comparatively shallow rooted. Deeper rooted perennials could well be introduced so as to use the available deeper water. Fuzzytop, which has a deeper root system and higher palatability than pili grass, is spreading over some of these arid lands. Some effort has been made to establish African foxtail (*Pennisetum ciliare*), which greens up quickly after each rain. This grass has a strong root system. Pitted beardgrass (*Andropogon pertusus*), also deep rooted but of comparatively low forage value, is invading some areas. Giant Bermuda grass (*Cynodon dactylon*) is growing in the favored spots, though it is marginal and does not produce as much feed as desired. Guinea grass grows in scattered clumps, but it is so palatable that it is easily grazed out. A desirable palatable legume has not yet been found for these lands.

Adequate grazing distribution is also a problem. Water is brought in from the mountains two to twenty miles by pipeline, with further distribution from tanks to troughs in the pastures. Construction of additional stock watering facilities where they would aid in more even grazing and reduce trailing is needed.

The Molokai Soil Conservation District, cooperating with the largest cattle ranch on Molokai, has developed a deferred rotation system of grazing that appears to be well suited to arid lands of this ranch. Under this system the grazing of large numbers of cattle for short periods in systematic rotation promotes a more even use and gives the range a better chance to develop vigorous plants and to reseed.

A forage improvement program has been initiated on this ranch for the sites adapted to reseeding. Successful reseeding is difficult, however, because of the erratic rainfall pattern and strong drying winds. A cultipacker seeder used after preparing a seedbed by subsoiling and

FIGURE 2. ARID AND SEMI-ARID ZONES

A. Arid kiawe-grassland, excellent condition range, deep red soil. Kiawe tree with guinea, fuzzytop, pili, and other grasses. B. Semi-arid range, fair condition, deep to shallow soils. Small guava and lantana brush with Dallisgrass, Bermuda grass, and rattail.

discing had been tried with fair success for the first time in 1950. In former trials, grass seeds were broadcast and results were disappointing, except for feather fingergrass (*Chloris virgata*) which, while aggressive and palatable, is an annual. Deep furrow drills also should be given a trial.

Kiawe should be eliminated from larger portions of these range lands so as to conserve moisture for the seeded grass.

The range improvement program on this ranch, consisting of reseeding, deferred rotation grazing, careful adjustments of stocking, and brush control, is designed to reduce erosion and increase the forage. Rapid improvement is expected when the selected deep soil areas are reseeded to carry a portion of the grazing load from the range now in poor condition.

Semi-arid zone

This is a transition zone for most plants, in that plants found may be common to either the arid or the semi-humid zones. Elevation varies from a few feet above sea level to 2500 feet.

Soils in this zone, while fairly fertile, are very uneven in depth. As is typical, the soils show little profile development. High winds and overgrazing have caused bald spots through this zone. It is difficult to establish vegetation on these bald spots unless given special treatment, such as mulching, ridging, or irrigation. In this zone there also are a few extremely shallow, heavy textured soils, locally called paapakaia, where it is also difficult to establish grazable vegetation.

The total rainfall should be sufficient to produce a fairly satisfactory forage cover, but is so erratic that results are spotty. The kona storms supply a part of the yearly total; trade-wind storms supply 25 to 50 percent. Here, as on the arid sections, the frequent winds reduce the possible beneficial effects of the intermittent rainfall—though the winds, except in a few hilltop areas, are not as continuous as they are in the arid zone.

There seems to be no grass or weed growing in this zone that dominates the other vegetation. The brushy lantana (*Lantana camara*) is an aggressive pest that flourishes on the best soils (Fig. 2B). It produces a cover so heavy that little else grows with it. Klu (*Acacia farnesiana*), a worthless spiny leguminous shrub, and koa haole, are found in the lower elevations. Small guava (*Psidium guajava*) also invade on the better soils. Bermuda grass and guinea grass do well in this zone when the aggressive invader shrubs can be controlled. Paspalum (*P. dilatatum*) does well, as does Natal redtop (*Tricholaena repens*), while molasses grass (*Melinis minutiflora*) has the virtue of establishing itself on the poor (paapakaia) soils. Other grasses are kikuyu (*Pennisetum clandestinum*), annual fescues, and bromes. Rattail (*Sporobolus capensis*), (Whitney, 1939), fuzzy-top and pitted beardgrass invade where competition is light. Sour grass (*Trichachne insularis*) is an aggressive perennial invader, but is unpalatable to livestock.

There are many weeds and forbs in this zone. Bur clover (*Medicago hispida*), mustards, *Amaranthus* sp., *Bidens* sp., and Jap tea are present. Spanish clover (*Desmodium uncinatum*) is a promising legume now on trial which appears to be not only excellent feed, but has the unusual ability to maintain itself in this environment. However, it has been slow to establish.

The season of green feed in this zone, usually five to eight months, is regarded as favorable. The trade-wind rains help keep the forage growing, though in ex-

posed spots the continuous winds dry up the forage in a short time, when more than a few days elapse between rains.

The reseeding of range and pasture forage plants in this zone is profitable. Lantana can be eliminated and the land planted to guinea grass, Bermuda grass, and kaimi clover.

Grazing distribution on the seeded pastures in this zone is not a serious problem as most of the units are small. Many acres of these seeded pastures, heavily overstocked in the past, will require clearing of brush and reseeding to develop full forage yields. Deferred-rotated grazing is indicated during the growing season. Grazable growth for eight months of the year is not unusual. One acre of good pasture will supply feed for one to two cows a month. Six to twelve acres are needed per year per cow.

Semi-humid zone

The yearly rainfall in this zone varies from about 30 to 40 inches. Elevations range from 500 to 2500 feet. The areas of good soils give excellent returns when cleared and planted to good forage species.

Soils are generally deep and fertile in the drainage bottoms. Adjacent gentle slopes, although rocky in spots, are also fairly productive. The benchlands, while often too shallow for pineapple, support good stands of grass (Fig. 3A). Erosion is not a serious problem on these lands because there is a generally good plant cover during critical periods.

The shallow soils on the steep slopes usually are covered with a short growth of guava, pilipiliula (*Chrysopogon aciculatus*), paspalums, molasses grass and weeds. Grazing on these slopes should be only moderate, especially when the area is composed largely of molasses grass. Molasses grass forms an excellent cover here, but invariably it is killed out by overgrazing and is replaced by less palatable plants which are difficult to eradicate. Because of shallow soil, there is some danger of severe erosion losses when the land is overgrazed, even temporarily, before a new cover of vegetation grows.

Guava and similar shrubs grow rank and shade out the forage plants once they gain a foothold on the benchland. Certain groups of these shrubs, whether grazed or not appear to grow in ecologic balance. In order to establish good forage plants on these soils, it is necessary to remove the shrubs. In drainage bottoms, guava grows to tree size, frequently so thick that livestock cannot penetrate the stand. Following the removal of the shrubs, kikuyu grass can be sprigged in on the better soils, molasses grass planted on the shallower soils and a range established, which can be maintained under good grazing management. If the land is planted in November, usually it can be grazed moderately the following July. Kikuyu is not regarded as the best forage plant, but is palatable and aggressive enough to keep out the shrubs if the first of such invaders are removed by hand. Bermuda grass also is being tried and shows some promise on the deeper soils. Dallisgrass is another excellent plant that is easily established, but it does not have the soil holding and water retarding capabilities of the other grasses. Kaimi clover grows well in this zone where it is now planted; more will be used as more seed becomes commercially available.

The big problem on these lands is that of brush control. Good stands of kikuyu grass, when established can be grazed almost yearlong. If care is used in grazing kikuyu, it will not become rank and unpalatable. The best solution to the problem of keeping kikuyu grass ranges properly grazed is to fence smaller paddocks

and rotate their use with larger numbers of animals.

foxtail are numerous and wherever there is a bare spot the plant grows rapidly.

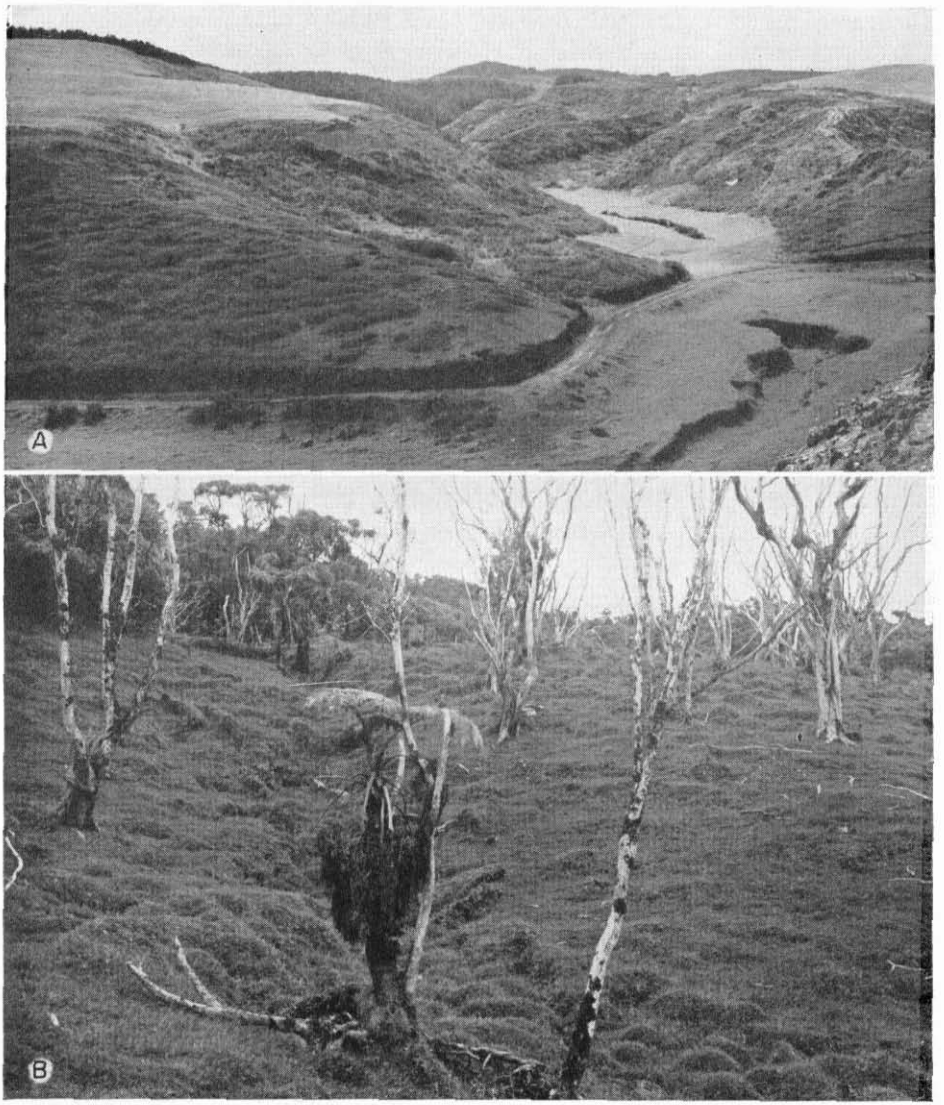

FIGURE 3. SEMI-HUMID AND HUMID ZONES

A. Semi-humid zone, deep to shallow soils. Kikuyu grass on bottoms and benches, excellent to good condition. Guava and lantana slopes with fair to poor condition pasture. B. Humid zone, poor condition pasture. Shallow soil with low pH. Ohia lehua and tree ferns dying. Overgrazed carpet grass and hilo grass.

A secondary problem is that of controlling the invasion of the relatively unpalatable perennial yellow foxtail (*Setaria geniculata*). The seeds of yellow

Proper management and a good tight cover of desirable plants will keep the yellow foxtail out of the pasture.

These "mauka" (mountain) pastures,

while limited in area, give good returns and help round out the grazing program for ranches situated so as to use them economically. Three to six acres of good, highland or foothill pasture carefully grazed will feed a mature cow yearlong.

Humid zone

The humid zone receives about 40 inches or more rainfall, well distributed throughout the year. The climate is cloudy and foggy much of the time. Soils vary sharply from deep to shallow with some of them poorly drained and most of them definitely acid. Many of the soils have a very high organic content.

These highlands were heavily forested prior to Capt. Cook's discovery of the islands. Guava grows on some of the land, but it is not as vigorous as it is in the semi-humid zones. Ohia (*Metrosideros collina*) and other shrubs and trees and many ferns cover the slopes on the shallower, more acid soils. Ferns and hilo grass (*Paspalum conjugatum*) dominate the more open areas (Fig. 3B).

Little work has been done toward rehabilitating these highlands for grazing. Kikuyu, molasses grass and Dallisgrass as well as the clovers may do well under this environment. Alta fescue has been suggested as a promising grass.

Year round grazing on these lands would appear feasible if the brush were cleared off and seeded to adapted forage species.

Watershed

A forest reserve lying to the north, northeast, and east of grazing lands described is maintained for the protection of the upper watershed. There are areas of grass in the forest reserve, but livestock are excluded because of the fear of damage from overgrazing.

There are large swamps in the reserve which hold quantities of water and at the same time allow it to move slowly oceanward. Most of the drainage of the reserve is toward the northern shore.

Brush covers extensive areas. Trees are small to medium size. The understory of grasses, weeds and ferns varies from sparse to heavy.

The valleys on the northeast side of the island might support livestock, but they are inaccessible except by water, and the sea is generally so rough that most ranchers are discouraged in trying to land on the beaches near them. Liver fluke is common in the wetter areas. Rice and taro were formerly produced in these valleys and shipped out by boat. The last work oxen from the abandoned ranches were reportedly shot several years ago. No people have moved back to these fertile but inaccessible valleys in recent years.

Summary

Molokai is a small island lying at about 21° N latitude. Rainfall may vary from less than 10 inches per year to over 150 inches, within short distances. Rainfall occurs as heavy storms on the arid sections, or throughout the year on the humid sections. Winds generally are constant and often severe.

The island is of volcanic origin, and while the soils vary in rockiness and depth these variations do not seem to markedly affect the plant species within the rainfall zone.

Pineapples are grown on the better arable lands in the semi-arid zones. The remainder of the island is used for grazing cattle and as a protected watershed to assure needed water supplies for lower lying lands.

Before the white man came there were no herbivorous animals, except the pig, on the island. The vegetation consisted mainly of species unpalatable to animals. Now, after years of cattle, sheep and

horses, the plant cover has changed. Most of the forage plants on the range today are not native and have been introduced from many parts of the world. Some of these plants are valuable and some are pests.

In order to better analyze the grazing problems, the island has been divided into five sites (rainfall zones) from arid to humid. Each supports identifiable plant groups and each presents problems peculiar to its zone. The challenge is to reseed the best species suited to each particular zone and follow up by applying the best known grazing management.

Range conservation plans on the ranches of the Molokai Soil Conservation District provide for clearing, reseeding and planned grazing. As the ranges and pastures are improved, resulting in better land use, more meat will be produced and a better living will be realized by the ranchers.

ACKNOWLEDGMENT

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A CHANGING CREED

For three hundred years we built a great civilization, and developed a high standard of living by the techniques of expansion, exploitation, and speculation. Our undeveloped natural resources were so great and our population so small that we succeeded beyond our wildest hopes. A belief in expansion, exploitation, and speculation became our creed. But gradually, imperceptibly, things changed. We changed them by following our old creed to the point where it was proved to be a fallacy. Now our creed is changing, changing to a belief in the need for conservation and a desire for security.—*Dr. Carl C. Taylor*, in Journal of Soil and Water Conservation, July 1950.

Importance and Development of the Reindeer Industry in Alaska

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Present Status

THE chief use that can be made of much of the tundra and adjoining forest in western and northern Alaska is the raising of reindeer. Aamodt and Savage ('49, p. 101) as a result of their special exploratory investigations in 1946 on cereal, forage, and range problems and possibilities in Alaska concluded: "The vast tundra area of northern, western, and other parts of Alaska may be utilized to best advantage for the production of reindeer, caribou, musk oxen, and possibly yak. This extensive and largely undeveloped domain is deserving of reconsideration for these purposes." The total potential area has been estimated as high as 400,000 square miles by Grosvenor ('03), and as late as 1945 by Palmer ('45A) at 150,000 square miles. Probably a total of about 100,000 square miles could be found now, but it would be safer to figure on about 50,000 square miles because of barren and worthless range, such as rocky slopes, gravel bars, lakes, marsh lands, overgrazed areas, burned-over lands, winter range that ices over frequently or where the snow becomes too deep, and areas frequented by caribou herds or subject to wolf predation where control is inadequate. Reindeer are dependent during the winter upon lichens chiefly, during the summer upon shrubs and herbs. Overgrazing and trampling in the past have depleted the lichens over a 10- to 20-mile wide strip along the seacoasts, so it is no longer suitable for winter range. In some areas, such as the western part of Seward peninsula, good winter range is so far away from the summer range that it is difficult to use either. In general there is insufficient good winter lichen range at present to make use of the large areas of summer shrub-herb range.

If a grazing requirement of 100 acres per reindeer yearlong (Palmer, '45A) is used, then 50,000 square miles would support 320,000 head, but even this estimate is unreliable because of the numerous problems and difficulties, and the small amount of basic data on which to base management of the reindeer and the range. The present policy of the Bureau of Indian Affairs of the Department of the Interior is apparently feasible with respect to encouraging the industry to expand in accordance with the selection of dependable Eskimos for purchasing herds as individuals and the assignment of areas for grazing that are free from caribou invasions and uncontrolled wolf predation, and where good winter range is accessible within a reasonable distance. Additional research is needed on range resources and on reindeer to meet the needs of the industry.

The total number of reindeer in Alaska as of June 30, 1951, was estimated at 27,245 in 17 herds, located chiefly in the Kotzebue Sound region, on Nunivak Island, in the Norton Sound region, and in the vicinity of Barrow (Mountjoy, '51). During the year ending June 30, 1951, 1700 head were butchered for sales, 957 of these for operators and other native use; the value of the meat and hides used and sold was $117,000; and

169 families secured part of their cash income from reindeer. The estimated value of the reindeer in Alaska was $546,900.

Aerial and ground surveys by the writer (Hanson, '52), chiefly in the summer of 1951, and to some extent in 1950 and 1949, showed that areas which had been heavily utilized during the period of large herds, or which had burned over, now have a sparse growth of lichens. Good lichen range does, however, occur in places 10 to 15 miles inland from coasts, especially near and in open spruce forests east of Norton and Kotzebue sounds, and in the southeastern part of Seward peninsula.

Growth and Decline of the Reindeer Industry

In 1891 Sheldon Jackson inaugurated the introduction of reindeer into Alaska from Siberia. By 1902 when the importations ceased, a total of 4795 head had been introduced, mostly in the western end of Seward peninsula, where W. T. Lopp and B. Gibson in 1891 had shown that lichens were abundant. In 1894 and 1898 Lapps, Finns, and Norwegians were brought to Alaska for teaching and working in the industry. From 1898 to 1904 damage to the range by fires, often started by miners, was pointed out. In 1911 the first shipment of reindeer meat, 125 carcasses, was made to the States. In this year counts showed 33,629 head in 46 herds, 60 percent owned by 460 Natives, 11 percent by the Government, 14 percent by missions, and 15 percent by Lapps. In 1912 there were 1281 head used as sled reindeer. In 1913 W. C. Shields stated that it was difficult to find summer grazing in several sections.

In 1914 the Lomen Bros. of Nome organized a company to produce and export reindeer meat on a large scale. Between 1914 and 1921 this company purchased about 8600 head at $18 to $30 each. It built corrals, slaughter and cold-storage plants, warehouses, etc.

The U. S. Biological Survey, now a part of the Fish and Wildlife Service, started research on reindeer in 1920 and this was continued until about 1935. The research resulted in publications by Hadwen and Palmer ('22), several by Palmer ('26, '29, '34, '45A, '45B), Palmer *et al.* ('33), and Palmer and Rouse ('45).

In 1925 twelve caribou bulls were landed on Nunivak Island for crossing with reindeer. In 1929 the supervision of the Alaskan reindeer industry was transferred to the Governor of Alaska. The trek of 3400 reindeer, starting from the Kotzebue region in 1929, reached the Mackenzie River delta in Canada in 1935. About 2,500,000 pounds of reindeer meat and 20,000 hides were shipped from Alaska in 1930. In 1931 a Reindeer Council, consisting of 5 members, was appointed to administer reindeer affairs; this was changed in 1932 to advisory capacity only. In 1932, when the peak number of about 641,100 head was reported, two representatives of the Secretary of the Interior found that problems of personnel, trespassing, herding, and marketing were aggravated by animosity, competition in trade, insufficient supervision, and neglect. Wolves were increasing in numbers. In 1937 the Reindeer Service was transferred to the Office of Indian Affairs and assigned to the Division of Education.

The Reindeer Act of 1937 (50 Stat. 900) authorized the establishment of a Native industry, restricting ownership to Natives, and authorized the appraisal for purchase of non-Native-owned reindeer. In 1940 the Government purchased from non-Native owners 84,001 head at cost of $333,003.00 and improvements at $112,925.72. The stated policy of the

Government was to assist the Natives in the conduct of the reindeer industry on a subsistence basis. Administration of the industry, including the use of the range, was transferred in 1941 to the Division of Extension and Industry and the Division of Forestry and Grazing. In 1949 the Alaska Game Commission reported killing in Alaska 488 wolves and 355 coyotes; in 1950, 1070 and 800 respectively. In 1950 the number of reindeer were estimated at 25,000, possibly the low point in the downswing. Belcher ('52) reported that at the close of 1951 wolf predation was serious among the herds in the Kotzebue region and on the Kakaruk herd on the Seward peninsula, and the Fish and Wildlife Service had inadequate funds to carry on predator control.

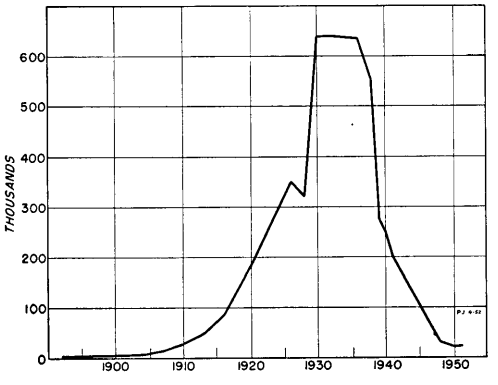

FIGURE 1. Trend in numbers of reindeer in Alaska from 1892 to 1951.

The numbers of reindeer in various years between 1892 and 1951 are shown in the graph in Figure 1. This graph is very instructive in showing the course of the industry. It shows the gradual increase in numbers up to about 1902, the moderate rate between 1902 and about 1912, the very rapid rate from 1912 to about 1930, the levelling off between 1930 and about 1934, the gradual decline to about 1938, the very rapid decline from 1938 to about 1945, then a gradual decline to about 1950, and a slight increase in 1951. The ascending part of this curve is typical of the growth of a population of animals in the presence of abundant food and in the absence of serious pressure by enemies such as predators, parasites, and diseases. This curve "provides a numerical measure of the population's past history up to the time of most recent observation; summarizes a wealth of knowledge about the group in question; and in so doing raises particular questions for analysis and synthesis" (Allee, *et al.* '49, p. 330).

This curve is one kind of a growth curve occurring generally in animal populations, especially the ascending or positive growth portion. An important difference, however, with the growth curves of many animal populations is the short duration of the equilibrium portion, and the practical absence of a period of oscillations and fluctuations following the levelling off. It shows instead an almost immediate decline after the maximum is reached. This indicates that the number of reindeer was permitted to increase far beyond the optimum in relation to the capacity of the areas occupied by them. If the number had levelled off at 300,000 to 400,000, a long period of fluctuation about a mean, or relative numerical stability, might have followed, instead of the crash. The levelling off, followed by fluctuations, has occurred following the introduction of animals in some countries, as when sheep were introduced into South Australia about 1838, and into Tasmania about 1814. In the first country the period of positive growth (1838–1890), resulting in a population of nearly 7,000,000 head, has been followed by a period of oscillations and fluctuations to the present. In Tasmania the population levelled off at about 1,600,000 head about 1856, and has been maintained

since then in a state of semi-equilibrium (Allee, *et al.* '49, chap. 21). It is more difficult to maintain a partly domesticated animal, as the reindeer, in a state of semi-equilibrium, but the goal should be to determine the proper point for levelling off (the asymptote) at which numbers could be maintained at a mean stability for a long time.

The curve in Figure 1, with such a rapid positive rate, followed by the steep negative rate, shows that insufficient consideration was given to the supply of food plants, range allotments, proper herding, etc., and the influence of these factors on the growth and maintenance of the reindeer herds. In fact, during the first 35 or 40 years, the forage, especially the lichens, was regarded (if at all) as almost limitless, and no one apparently thought they would ever be depleted. During this expansion period "Everyone was optimistic. No one issued warnings that the balance of nature would operate inexorably, that in this unhealthy development of wild reindeer lay the seeds of the reindeer business's destruction. Reindeer owners, Native and white, made effort to acquire as many reindeer as possible. . . . Owners made no effort . . . to limit the number of reindeer to the amount of plant life the ranges would support in perpetuity" (Rood, '45, pp. 5–6). The over-optimism, as late as 1934, is shown by Palmer ('34, p. 5) who estimated the area of grazing land suitable for reindeer in Alaska at 200,000 square miles with a carrying capacity of 4,000,000 head, and an annual surplus of 1,000,000 hides and 10,000,000 pounds of meat.

"Apparently in every area where reindeer have been introduced they have increased rapidly in numbers to a peak, and then a decline has set in. This is a biological cycle in a natural state, as animals increase in numbers until feed is insufficient to carry the greater number or predators increase to a point where the host cannot support them. The primary animals then decrease rapidly and the feed supply builds up or the predators die or migrate. With better food or fewer predators the primary animals start increasing again on another cycle. Man upsets this course in domestic animals by the safeguarding of feed or protection from predators, and theoretically should be entitled to the surplus or harvest. Where no surplus exists the cause is usually attributable to neglect—voluntary or otherwise. In the reindeer industry this neglect is ordinarily lack of herding" (Burdick, '40, p. 25).

At present it seems hardly believable that lichens were ever abundant near the coasts, where the reindeer were mostly located during the positive growth period. But statements by various observers indicate that they were. Palmer ('34, p. 24) wrote: "When reindeer were first introduced into Alaska, the immediate coastal areas contained a considerable cover of lichens—now largely disappeared —owing probably to the earlier close confinement of the herds to the coast." He used in his 1926 publication a photograph showing men gathering lichens from a dense stand close to the seashore, apparently near Nome, now depleted. Again in a photograph, Palmer and Rouse ('45) showed the excellent stand of lichens in the Dexter Creek area about 8 miles north of Nome. They stated that in 1922 the cover of this stand consisted of 92 percent lichens and the height was 3 to 5 inches, and that little change took place in the 10 years following 1922. In 1951 the lichens in this same stand, which had not been grazed for several years, averaged 1 to 2 inches high, and the cover varied from 50 to 90 percent. It is remarkable that the cover and height remained good near the coast in the vicinity of Nome for such a long time, and that

depletion did not occur until after 1932. This shows a striking relationship to the beginning of the decline in the growth curve of the reindeer population (Fig. 1).

Other indications of the abundance of lichens near the coasts are given by various writers. Smith ('13) stated that reindeer moss was abundant on the hill slopes between the mouth of the Noatak River and Cape Krusenstern and was being grazed by reindeer. The region now has only poor growth of lichens. Shields (Anon. '16) reported that in 1916 lichens were stored for feeding his sled reindeer before his arrival at Candle, Nome, Chiniak, Council, Kotzebue, Teller, and Sinuk. In 1950 and 1951 it was impossible to find enough lichens for such a purpose in most of these places. Jackson ('01) reported that lichens were abundant the whole distance from near Unalakleet to St. Michael and then to Bethel during a reindeer drive. John Muir ('17) described "the furred bed of lichens and mosses on which the bright leaves and berries were painted" in the Kotzebue Sound region in 1881.

The decline in the number of reindeer after about 1932 was due to many causes and should not be attributed to only one. This is usual in the crash of animal populations (Trippensee, '48, p. 391). The chief cause was undoubtedly the depletion of the ranges that were used and the failure to move herds to good unused ranges. Another chief cause was inadequate herding. Predation by increased numbers of wolves became more serious, but undoubtedly many losses due to other causes were attributed to wolves. Careful herding would probably have prevented much loss by wolves, but their predation appears difficult to prevent in brush and timber and during the winter. Even today in northern Norway losses due to wolves are often heavy.

The depletion of the range was due to excessive grazing and trampling, during both summer and winter in many areas. This was accentuated by the concentration of reindeer on limited areas. Fire was serious, especially in the destruction of lichens. Inadequate herding was due to the unwillingness of herders to endure the hardships and inconveniences of following the herd, crude range facilities in places, conflicts between herders and owners, village attractions, absentee ownership, lack of adequate regulations and enforcement, and lack of enough knowledge and appreciation of the range and the habits and requirements of the reindeer not only among the owners and herders but also among the supervisory officials. During the thirties interest in reindeer declined, brought on partly by the system of joint ownership, partly by the low value of reindeer products, partly by marketing difficulties some of which were caused by objections in the states to importation of reindeer meat in competition with that of domestic livestock. Poor herding, or the lack of any herding, contributed to losses from wolves, and probably some from bears, to starvation in severe winters and the springs following, and to straying off with caribou or in search of better range. Other causes of the decline in numbers were the excessive slaughtering, not only for human food, but for dog food, fox bait, etc.; losses by parasites and diseases, especially in weakened animals; inbreeding; excessive numbers of bulls; over-optimism; lack of enough trained personnel and efficient supervision; insufficient instruction about reindeer and range management in the schools; insufficient research; and failure to put into practice valuable recommendations made by competent investigators and others such as Palmer ('36, '29, '34), Burdick ('40), and Arnold, Cooley, *et al.* ('41). There was insufficient assistance and guidance by government

agencies especially after the transfer of ownership from Whites to Natives, when the industry was changed from a commercial to a subsistence basis. It is no wonder that the decline in numbers was so rapid, and that by 1941 reindeer raising in Alaska was "a very sick industry," as reported by Arnold, *et al.* ('41).

should not be established until reliable, trained, and cooperative operators and herders are secured. Regulations governing the use of the range and management of the reindeer are in preparation, and conformance to them under efficient supervision will be essential. It is the opinion of the writer that Eskimos interested in the reindeer business can be

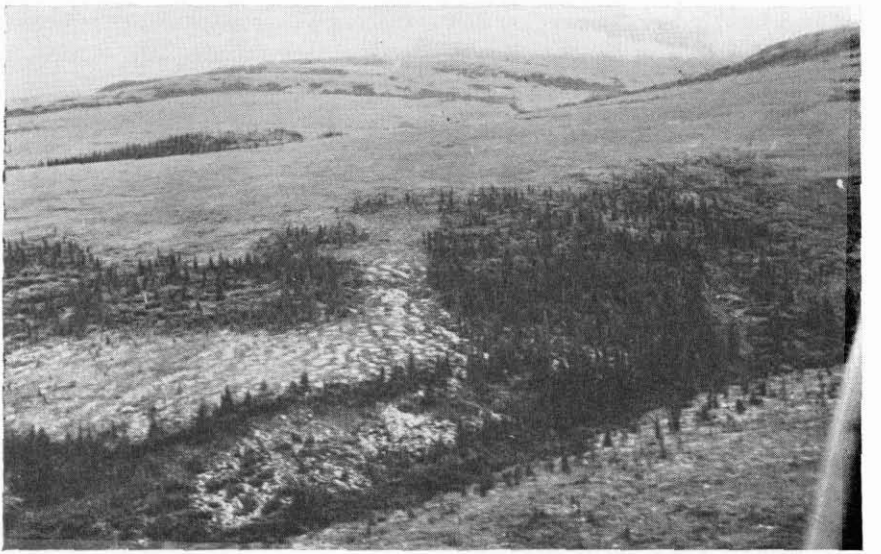

FIGURE 2. An excellent stand of reindeer lichens in the dwarf birch-heath-lichen type between stands of white spruce-shrub type. Wide areas of the cottongrass-sedge-dwarf heath shrub complex. Alder thickets on hillsides in the background. The Ungalik River valley, east of Norton Sound, July 31, 1951.

FUTURE OF THE REINDEER INDUSTRY IN ALASKA

In view of the numerous problems and difficulties, and the sad history, there appears to be little question that the development of the industry should be gradual. The locating of herds should be controlled so that only areas where there is an adequate supply of lichens on the winter range (Fig. 2) and on the fawning range will be used, where there is freedom from invasions by caribou, and where wolf control can be obtained when needed. The prevalence of diseases and insect pests also needs consideration. New herds found and trained as the industry grows, but more aid and interest in instruction may be needed from the Alaska Native schools and Territorial schools than seems to be the case at present. Instruction about range resources and in reindeer husbandry should be given in many of the schools, and interested boys should be given opportunity to secure practical training in herding with the Government herd or other herds under good management. If their interest continues, apprenticeships should be made available. The present loan and repayment agreements with purchasers of new herds, involving

repayment in kind, appear, on the whole satisfactory.

The development of the industry will also be governed by the opportunities for marketing meat and hides. It appears that marketing should be limited chiefly to the home needs of the Eskimos and to markets in Alaska. "Investigations and studies of the reindeer industry should be made in order that the herds will play the greatest possible part in the general development of northern and western Alaska. Food and clothing requirements of the natives should be the first concern of the industry" (Burdick, '40, p. 25). Heintzleman ('36) stated that it seems reindeer production should be restricted to local needs and abandoned as an export business. At present there is much greater demand in Alaska for reindeer meat than can be supplied. The export of meat to the States involves many additional problems and need not be considered at present, at least not until the industry has grown considerably, the Alaska consumer demand is satisfied, and the demand for meat in the States exceeds available supplies. Transportation of meat and hides is not so great a problem as earlier because planes can be made available in most places when needed.

Sound development of the industry requires that the range resources of each grazing unit should be surveyed for major range types (Hanson '51, '52), classified into range condition classes, and the carrying capacities estimated. A grazing plan is needed for each unit, which will show the seasons of use, routes of travel, camps, frequency of grazing, rotation plan, places and time of handling (Fig. 3). Regular reports should be obtained from operators at least once a year regarding conformance with the grazing plan, numbers and sex of fawns, deaths due to predators or disease, number slaughtered, castrated, etc.

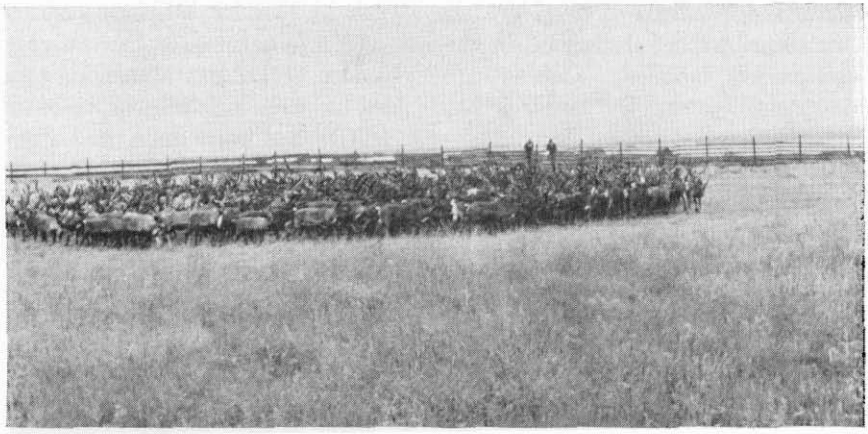

FIGURE 3. Reindeer milling, anti-clockwise, in the corral at Grass Lake on the Seward peninsula. August 5, 1951.

In the evaluation and management of reindeer ranges many factors must be taken into consideration in addition to the kinds and abundance of forage plants. Some of the climatic factors to consider are the frequency of icing-over, or crusting, and the depth of the snow during the winter; direction and intensity of the wind (reindeer travel against the wind); duration of light; temperatures; humidity; kinds and times of precipitation. Soil

and topographic conditions that influence management are the dates of freezing and thawing of the ground, rivers, lakes, and the sea; the amount and duration of soil moisture contents; frost action in the ground; kind of soil; ice action along the coasts, relief; ruggedness, etc. Biotic factors to consider are diseases and parasites, predators, caribou, forest and shrubs for fuel, shelter, etc. Fire, because of its destructiveness is almost in a class by itself, but it is usually started by man. Other human factors to consider are the abilities and inclinations of owners and herders, market needs, transportation facilities, etc.

The operator who is building up a reindeer herd should be given necessary kinds of assistance such as instruction in better methods of management of reindeer and range, in securing herd dogs, and in the construction of facilities. Cabins are needed especially during the winter and at handlings. Whenever possible encouragement should be given and interest shown in solving his problems. The giving of the proper kinds of assistance, not doles, requires direct and personal knowledge, gained on the ground, of the problems and needs of each operator. At present this is impossible with the very small staff engaged in reindeer administration; consisting of the part time of the Assistant Director of Resources in the Juneau office of the Alaska Native Service, part time of the Administrative Assistant in Nome, another in Kotzebue, and part time of a few teachers. All of these people have so many other duties that it is impossible for them to keep in close touch with the needs of the operators and with the condition of each herd and range. Furthermore, most of them lack the needed kind of technical knowledge for this work. At least two scientifically trained assistants are needed to work under the Assistant Director of Resources. One should be competent in research, the other in extension work and administration.

Before sound, long-term range management procedures and plans can be formulated, much additional knowledge must be secured by research. A few of the problems that need the services of a competent research man are surveys to determine the locations of range suitable for the different seasons, effects of various frequencies of grazing, values of different species of plants at various times of the year, rate of recovery from various intensities of grazing, nature and extent of wolf predation, control of losses due to caribou, and the needs and habits of the reindeer. Sample plots, to be examined and measurements taken about every two years, should be installed in several range types and under different conditions of use. Examinations of the range, of the reindeer, and of the influencing conditions need to be made at all seasons of the year. So little has been done, and there is so much to do, that the full time of one man should be given to research. This is little enough, in view of the extent of the reindeer country and the need of the industry for basic information, if it is to become established on a technically sound foundation.

Another assistant to the Assistant Director of Resources is needed to help in administrative matters, such as checking the tallies at reindeer handlings, aiding operators in filling out reports, advising about market needs and opportunities, etc. He is also needed to conduct extension activities, advising operators about improved management methods for both reindeer and range, as well as marketing. He would aid in the teaching of apprentices. Another need is to disseminate information to consumers about the availability, uses, and preparation of reindeer meat and skins. He would also work to secure better appreciation and coopera-

tion of the Alaska Native Service schools and the Territorial schools in the reindeer industry and in the training of apprentices. At every opportunity he would point out the destructive and long-lasting damage wrought by fire, excessive trampling, and other abuses, especially to the lichen range; and the need for cooperation by all in the development of a sound reindeer industry.

Note

In a paper received after this article was in page proof, Scheffer ('51) ascribed the decrease in reindeer on St. Paul Island to a number of causes, primarily overpopulation.

Acknowledgements

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Farming Range Pastures

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(A talk presented at The International Livestock Farmers' Meeting, Williston, North Dakota, November 2, 1951.)

IT is always a pleasant assignment for me to talk about pasture and grazing. It is an exceptionally happy event when the audience is international, because pasture is an international crop. Although we may associate the production of tea with China, dates with Arabia, and coffee with Brazil, nevertheless pasture is an important crop in these countries also. In New Zealand, Australia, Argentina, as well as in many other lands, pasture is the principal source of agricultural wealth. Not only is pasture of universal interest, but it is one of the world's largest crops.

The title of this talk is "Farming Range Pastures." It was chosen because the basic principles of good farming apply to range pastures as much as to any other crop: good land management returns high yields and reduces soil erosion; crops adapted to a climate produce higher returns; careful decisions about dates of harvesting ensure high quality crops; and reserves of moisture, fertility, and feed assure continuity of production. These are the principles which the title considers; these are the points I hope to develop as my talk progresses.

Pastures of the Northern Great Plains

Pastures throughout the Great Plains of North America, and particularly within its northern section, consist largely of native grasslands. In the Province of Saskatchewan, over 90 percent of our grazing comes from this source, as well as over 60 percent of all fodder consumed by livestock. The land which produces this wealth is largely nonarable, being either arid, stony, steeply rolling, or saline. In all probability, this land will remain as an unimproved resource for many generations, and the care we give it now will determine its productivity in the future.

Let us examine the characteristics of our native grasslands. It will be appreciated by all that they vary in composition from district to district. In the shortgrass country blue grama grass is the most abundant. Speargrasses and wheatgrasses dominate the cover in the mixed grass prairie area, while fescues and oatgrasses are the principal species in the foothills of the Rocky Mountains. But, despite the fact that different grasses occur from region to region, the vegetation has certain characteristics in common—some of which are valuable and must be preserved, others are weak and thus need care and help.

Strong points of native grasses

Our native grasses have five valuable or strong characters:

1. They recover rapidly from drought.
2. Production is maintained when good management is practised.
3. Many grasses cure on the stem, thus retaining a relatively high total digestible nutrient content for many months after growth ceases.
4. Different species of the grass cover commence growth at different dates during the spring, thus there is

young leafy fodder available during a fairly long growing season.

5. Nearly all have high nutritive and palatability ratings.

Recovery from drought—This is a remarkable quality possessed by native grasses. Many of us will remember the dry years of 1937 and 1949 when native grass production was only about 10 per cent of average. During those years, the grasses and the weeds appeared to be dead, and the covers were reduced greatly. Yet many stockmen cut hay on those same fields in 1938 and 1950, and not only was the yield satisfactory, but the cover was back to average. The ability of our native grasses to recover rapidly from drought is a blessing we often forget when native grasslands are discussed.

Good management—Although range pastures recover rapidly from drought, they do not recover quickly from overgrazing. Overgrazing accompanied by drought, or overgrazing alone, depletes stands and reduces yields. Overgrazing can be prevented by knowing the carrying capacity of a pasture and stocking it accordingly. Although we usually state carrying capacity as so many acres per animal, my definition of carrying capacity is as follows: "The amount of grass required to produce a gain of at least 325 pounds of beef on a 2-year-old steer between April 1st and November 1st." Good management of range pastures will maintain this yield year after year, as well as the composition and stand of the grass cover.

Curing on the stem—There have been many words spoken and written about the ability of range grasses to cure on the stem. Curing is hard to define, but there are two points which help to describe this phenomenon. Firstly, curing is a process which prepares the grasses for the long winter dormancy; secondly, the process seals nutrients within the plant cells so that the food supply is not lost by leaching. From the viewpoint of the plant, it is growing its winter coat; from the viewpoint of the animal, the cured forage is a source of palatable feed which has a high T.D.N. rating—although low in protein and phosphorus. When we consider that most grasses dry up or even disintegrate when growth ceases, the curing character must be considered another blessing.

Growth seasons and nutritive value—Figure 1 illustrates the association between the growth periods of selected grasses and the approximate rate of gain of 2-year-old steers on mixed grass prairie. The spearheads represent the spring growth season of six grasses—five native and one cultivated. The wide part of each blade indicates their seasons of rapid growth, the points the beginning and end of their growth periods. In certain favourable years, growth continues to a later date and, in any year, it may recommence in the autumn. However, it is the spring growth which provides the seasonal forage and the carryover; autumn production is variable and uncertain.

It will be noticed that different grasses commence and end growth at different dates. The majority mature in about 100 days, but because some start early and others later in the season, the period of growth is extended to nearly 120 days.

Throughout their growth periods, the grasses are palatable and nutritious, and livestock will make rapid gains while pasturing them. Two-year-old steers will gain from 1.5 to 2.5 pounds daily during this season. By September, the rate of gain will be less and, by mid-November, the daily gains are small. However, gains will still be made at this late date, whereas on many other grass associations, livestock will lose weight after mid-October.

Recovery from drought, productiveness

under good management, the curing character, and high nutritive ratings during the growing season are the strong properties of native grasses. These must be preserved to maintain livestock production throughout the northern Great Plains.

325 pounds each summer. This is the driest part of the province, and fewer acres will produce the same gain in more favoured districts. However, even under our best conditions, it will require at least 8 acres to grow enough feed for one steer.

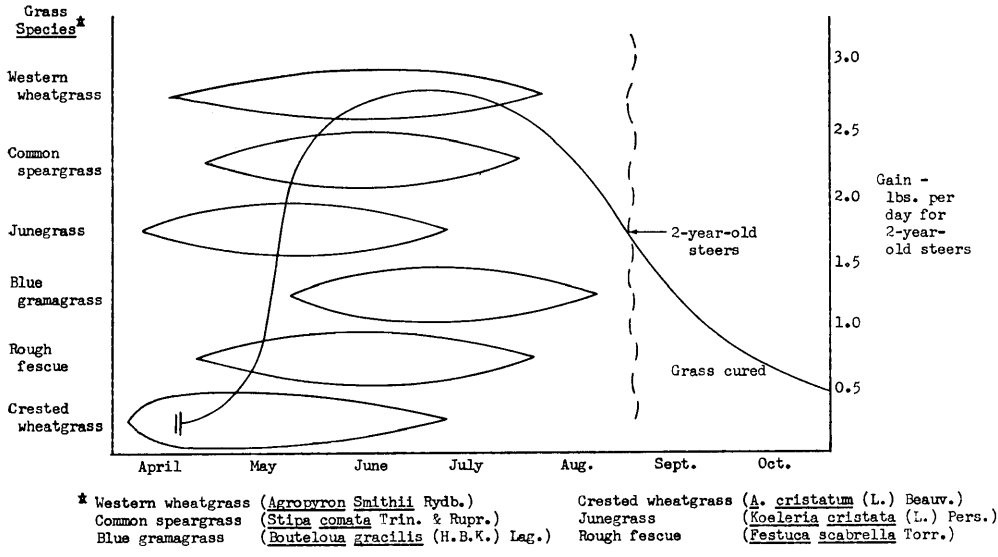

FIGURE 1. Growth periods of selected grasses, and gains of two-year-old steers on mixed grass prairie.

Weak points of native grasses

Unfortunately, few things are perfect, and our native grasses have weaknesses which we must pamper:

1. Their yields are relatively low, thus large acreages are needed to produce a summer gain of 325 pounds on a 2-year-old steer.
2. A "carryover" of the current season's growth is required to maintain a productive stand.
3. Growth is slow for 4 to 5 weeks after the leaves emerge in the spring.
4. Protein and phosphorus contents drop as the summer progresses.

Low yield—Native grasslands are not high producers. It requires about 35 acres in southwestern Saskatchewan to provide enough feed for a steer to gain

Carryover—Even this low rate of grazing cannot be practised unless a carryover is maintained. I define carryover as the amount of grass which should not be grazed. During years of average growth from 40 to 50 percent of the season's total production should be left at the end of the grazing period. None may remain during poor years, while most of a good season's growth may not be eaten. Carryover holds snow, reduces erosion, and provides a bite for the animal the following spring. Carryover is a pasture reserve as much as a full stockyard is a hay reserve.

Slow spring growth—Our native grasses grow slowly during the spring. This slow growth continues for 4 to 5 weeks after the grasses show their first green leaves.

Relatively rapid growth commences in late May and continues until mid-July, after which very little growth occurs. Reference again to Figure 1 will indicate the growth curve of certain species—slow at first, relatively rapid during late May and June, and ending sharply at maturity.

Heavy use during the period of slow growth reduces production later in the season as well as the total yield for the year. However, if protection is practised until date of range readiness, greater mid-season growth is secured as well as a much higher yield. Our investigations show that heavy spring use is as responsible for overgrazing as is heavy stocking throughout the year.

Loss of nutrients—The fourth weak point exhibited by the native grasses is the loss of protein and phosphorus. Their percentage contents decline rapidly from early June until late August. The loss continues after curing is completed, but at a considerably slower rate. Reference to Figure 2 will indicate the average percentage contents of both nutrients throughout the summer.

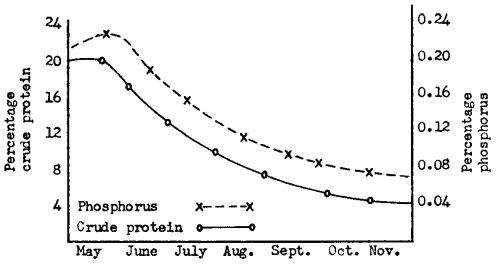

FIGURE 2. Average crude protein and phosphorus contents of mixed grass prairie from May through November.

How Can We Manage These Weak Characters?

So far, I have said little about "Farming Range Pastures". Instead, I have attempted to show that grasses have characters as has every other crop. If all characters were strong, we would have few grass problems, but because a few weak ones occur it is necessary to manage our rangelands. Thus, the question before us can be stated as follows: "How can we manage or improve the weak grass characters so that full use will be made of those which are strong?"

The first weak point is low yield, and overgrazing may reduce it to even lower levels. Attempts to increase yields by rotations have not been encouraging, although small improvements in the grass cover have been demonstrated in three field rotations. Thus, on fields containing native pasture only, we recommend that they be grazed continuously throughout the summer at a moderate rate.

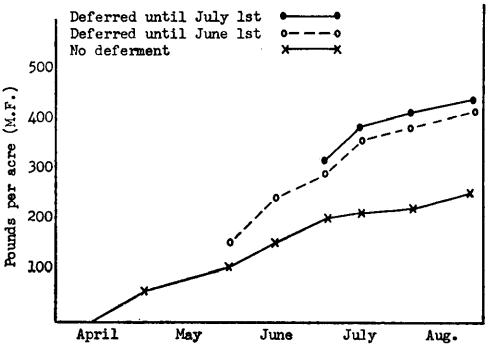

FIGURE 3. Yield of mixed grass prairie under deferred clipping at Swift Current, Sask. (Four-year average 1948–51 inclusive.)

However, increased production is possible as reference to Figure 3 will indicate. The results presented are selected from a clipping experiment which deferred harvesting of mixed grass prairie by two-week intervals. Plots protected until early June produced 65 percent more forage than those clipped from late April through September. A further small increase resulted from protection until July.

In practice, we cannot wait until early or mid-June to commence grazing. We have to choose between two alterna-

tives—graze early and accept a lower yield, or provide supplementary pasture for the spring season. Fortunately, we have a grass which grows rapidly during the spring and which can be grazed at that time, namely, crested wheatgrass. Crested wheatgrass used as spring pasture in a two-crop (spring-summer) rotation with native range, can nearly double the grazing capacity of mixed grass prairie in southwestern Saskatchewan. Increases of 60 to 90 percent have been obtained, the highest being on land with sandy soils.

early in the season, there is little increase in carrying capacity; if made too late there is a marked reduction in the amount of both forage and protein available. In order to practise the number 3 rotation, it is necessary to provide from two to three acres of crested wheatgrass per animal unit.

In a Community Pasture of 18,000 acres near Swift Current, Sask., where cattle follow naturally the rotation recommended, the grazing capacity is 12 acres per animal unit for a six-month grazing season. On adjacent range where no

TABLE 1

Possible rotations of crested wheatgrass and mixed grass prairie based on clipped plot yields 1948 to 1951 inclusive

POSSIBLE ROTATIONS			SUMMER YIELD LBS. PER ACRE			
No.	Grazing dates		Forage (M.F.)		Crude Protein	
	Crested wheatgrass	Mixed grass prairie				
1	Apr. 15–May 16		270		44	
		May 16–Sept. 1		240		58
2	Apr. 15–June 5		395		64	
		June 5–Sept. 1		385		64
3	Apr. 15–June 20		430		69	
		June 20–Sept. 1		410		73
4	Apr. 15–July 5		455		71	
		July 5–Sept. 1		440		55
5	Apr. 15–July 20		460		70	
		July 20–Sept. 1		360		36

The results of a second clipping experiment are summarized in Table 1, and demonstrate some practical aspects of a two-crop rotation. Five possible combinations are presented. We recommend the one listed as number 3 as being the most satisfactory. These data show there is very little increase in the yield of crested wheatgrass after mid-June, and that the stand is not adding protein. Mixed grass prairie adds to its annual production until early July, but protection after that date adds little to pasture reserves. If the change from crested wheatgrass to native range is made too

supplementary pasture is provided, some 22 acres are needed to produce the feed required for the same period.

Although we can nearly double the carrying capacity of rangelands by grazing crested wheatgrass during the spring, this improvement is not enough. Our aim should be to triple our pasture resource. Our soil is sufficiently fertile and we have enough rainfall to produce higher yields, providing we can find the right plants. Insofar as the spring season is concerned, I do not believe that a much better perennial grass than crested wheatgrass can be obtained. Consequently, we

will have to look to other seasons and other plants to achieve a three-fold or greater increase in pasture production.

Another weak character suggests a possibility for increasing grazing capacity, namely, the loss of protein during the summer. As pointed out previously, the loss of protein is associated with smaller livestock gains and thus a lower carrying capacity. Supplementing range pastures with high protein feeds during this period has increased the yield of beef per acre at a reasonable cost. Unfortunately, this practice does not improve pastures nor does it provide a permanent protein supply.

A permanent protein supply has to be grown. Grasses and legumes are needed for this purpose. From the multitude of plants tested in Saskatchewan, four new grasses establish satisfactory stands and have characters which are useful for range regrassing. Streambank wheatgrass (*Agropyron riparium* Scribn. and Smith) develops an excellent bottom and is drought tolerant. Intermediate wheatgrass (*A. intermedium* (Host) Beauv.) produces well, but is insufficiently drought tolerant and winter hardy for the drier sections. Green stipa grass (*Stipa viridula* Trin.) retains its protein content later in the summer than mixed grass prairie. Russian wild ryegrass (*Elymus junceus* Fisch.) retains a relatively high protein content into late fall and is hardy and palatable; it is recommended for late summer and autumn grazing throughout the mixed grass prairie area in Western Canada.

But even more than the need for grasses is the need for legumes. Our native grasslands contain few palatable legumes, in fact many contain poisonous properties. Our ambition is to obtain an alfalfa or other legume which will persist under grazing, which will live in our environment, and which will add protein and other nutrients to summer pasture. Plant breeders are making excellent progress to secure such a plant.

Thus, I forecast that the carrying capacity of range pastures will be increased beyond the 60 to 90 percent level which we can achieve today. I do not expect that a single crop or even half a dozen will meet our needs. But the intelligent use of those we have and those we obtain soon will repay our industry. The group of plants we select must possess the following characters:

1. Provide greater yields of forage and nutrients.
2. Retain a high protein content throughout the summer.
3. Possess the ability to cure on the stem so that pasture reserves can be maintained.
4. Be able to recover rapidly when good growth years follow periods of drought.

Summary

The native grasses form the base of the grazing resource in the northern portion of the Great Plains. They have certain strong characters as well as a few which are weak. Unless it is possible to supplement native ranges with seasonal pastures, it is better to graze continuously at moderate rates than to practise rotations. A summer gain of at least 325 pounds on a two-year-old steer should be maintained year after year, while a 40 to 50 percent carryover is not too much during an average growth season.

Protection of native grasslands until dates of grazing readiness is another very important practice to follow. A supplemental pasture of sufficient size to carry an animal until early or mid-June is recommended. In southwestern Saskatchewan, from two to three acres of crested wheatgrass pasture per animal provide feed during this period, and increase the

carrying capacity of native range by 60 to 90 percent.

Further increases of carrying capacity will be secured when crops are available to provide protein supplements for autumn pasture. Russian wild ryegrass is the best grass available at present for this purpose. Progress is being made to obtain improved alfalfa strains, suitable for late season grazing.

Finally, and most important, "Farming Range Pastures" in the Northern Great Plains is most successful when substantial reserves are provided. Reserves of pasture for all seasons of the year are essential, while reserves of hay for at least two winters are not too much.

Rudyard Kipling describes the luckless life of the rice farmer of India with the following words:

"His speech is mortgaged bedding,
On his kine he borrows yet,
At his heart is his daughter's wedding,
In his eye foreknowledge of debt.
He eats and he has indigestion,
He toils and he may not stop,
His life is a long drawn question
Between a crop and a crop."

Undoubtedly, Kipling never knew about "Farming Range Pastures." Had he been acquainted with that phase of agriculture, I am certain that his poem would have been a happier one. With apologies to Kipling, I present my parody of his serious composition, and attempt to describe the more fortunate position of those who are "Farming Range Pastures":

"His land is not eroded,
His cattle he fattens yet
On soils which are fertile and stable,
His worries are not of debt.
His crops are safely garnered,
He fears neither cold nor rain,
He farms for pasture and profit
With reserves of fodder and grain."

RANGE MANAGEMENT FOR HUMAN WELFARE

The ultimate objective of range management, as of forestry or crop agriculture, is of course human welfare. Conditions in thousands of communities and even great metropolitan centers reflect adversity or prosperity on the range. All too frequently; improper management or abuse of the range has resulted in reduced livestock production; in far-reaching damage from floods, erosion, and siltation, in impoverishment of peoples and weakening of nations. Production from the range land can be increased, the lot of peoples dependent upon the range resources can be improved, and the economy of communities and nations strengthened and stabilized when improved range management is applied.—*Lyle F. Watts*, Chief, U. S. Forest Service, In Unasylva, April-June, 1951.

Range and Livestock in Tropical Savannahs of British Guiana

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IT is common knowledge that the world's largest expanse of tropical forest occurs in the interior of South America. It is a less well-known fact that this great tropical interior also contains many millions of acres of grassland in Venezuela, Colombia, Brazil, and the Guianas. It is an area of monotonously hot weather near the equator at elevations of only a few hundred feet. Rainfall is seasonal in character with a wet season and a dry season, both of which are likely to be extreme.

This discussion is devoted to the savannahs of the Guianas, which differ from the other grasslands of the tropics only in detail. Guiana savannahs are in fact an extension of the savannahs of Brazil and the plains of the upper Orinoco in Venezuela.

The tropical grassland is generally stocked with cattle. Yields of beef are now very low due to a number of factors including poor quality animals, nutritional deficiencies, poor ranch facilities, and lack of transportation. However there is definite evidence here and there that a satisfactory beef production can be attained.

Nature and Type of the Savannah

The Guiana savannahs lie principally between 300 and 600 feet elevation. Temperatures are uniformly hot throughout the year but not excessively so, rarely rising above 100°F. The wet season, or period of heavy precipitation, is from April to September. Rainfall varies from 60 to 70 inches annually of which 65 to 90 percent comes in the wet season. Extremes of rainfall are as important as the average and a range in annual precipitation has been recorded of 40 to 100 inches. Any comparison however of these figures with the rainfall of temperate zones is of doubtful value because of the difference in conditions. There are periods of six months in drouth years without effective rainfall. A much shorter time than this produces drouth conditions that may be severe in the savannah uplands. It is obvious then that the vegetation must be able to endure extremes of wet and dry cycles.

The savannah grasslands occasionally occur near the coast, intermingled with the forest or "Bush," as it is called in the tropics regardless of size of the trees. Savannahs increase in area toward the interior and are continuous except for stream courses and isolated mountain areas in the part of the interior known as the Rupununi savannahs in Guiana. The same savannah extends over a large area in Brazil on the Rio Branca, a tributary of the Amazon.

The origin and development of these grasslands present some interesting problems for speculation and study by ecologists. It seems most likely that they are carved out of the forests by a combination of drouth and fire. Fire was common before white settlement and has increased since that time.

The long dry season is not favorable to trees but does not prohibit their growth. However this is certainly a major factor in the dominance of the grassland. The

relatively infertile soil, which has a low water-holding capacity, is a contributing element that retards a return of forest.

The line of demarcation between forest and grassland is sharp and distinct. This would appear to be due to fire that does not invade the lush green tangle that makes up the Bush along streams and mountains but that makes short work of any isolated seedling from the Bush that attempts to invade the grassland. There is now a slight but definite trend toward encroachment of the savannah into the Bush, which is unquestionably due to fire. There is also evidence that this trend may be reversed under some circumstances.

The savannahs are, as the name implies, not entirely devoid of tree cover. The most common tree is a small scrubby plant called sandpaper tree (*Curatella americana*) from the rough surface of its large leaves. This tree rarely grows more than 15 to 25 feet tall and is well adapted to survive drouth. It is quite resistant to fire although the seedlings and young plants are often killed in burning the grass cover.

There are two principal variations in the savannah resulting from the undulating character of the terrain. One is the lowland subject to flooding in the wet season, and the other is the upland that is never subject to prolonged flooding. The nature and character of the plant cover of the two sites is radically different.

The lowlands or swamps are under water during most of the wet season. There is a gradual drying up with the onset of the dry season until all but the lowest parts are dry on the surface and there may even be drouth effects. Prior to introduction of cattle and horses, the swamps were soft and spongy and could not be crossed much of the time. The constant trampling has now resulted in compacting of the soil so that they can generally be traversed by livestock even when covered with water. The vegetation is grass and sedges that can endure this situation. The grasses are *Andropogon*, *Paspalum*, and a few others, together with many sedges and rushes that grow tall enough to project above the water. They are coarse and harsh, and generally not grazed to any extent except when young shoots can be reached. Consequently fire has been common here as well as on the upland to make the young growth available to grazing livestock. When the water recedes, a number of other species appear. Some of these are annuals that come from seed. Some are perennials that come from either dormant rootstocks or have managed to survive by maintaining a few green leaves floating on top of the water. Most of this group root from the nodes of the stems and spread over the ground quickly forming a sward of fairly palatable grazing after the water recedes. *Paspalum*, *Panicum*, *Thrysa*, and *Axonopus* are the principal grasses of this group.

There are a few species, such as wild rice (*Oryza perenne*), that have almost completely disappeared. This is a large coarse grass that is palatable and that can endure extremes of flooding. It was probably never the principal grass but was formerly more common than at present. Other grasses that have decreased in the swamps are *Pennisetum*, *Manisuris*, and *Sorgastrum*.

The uplands are an entirely different situation (Fig. 1). The dominant grasses are coarse and harsh, although much smaller than the swampgrass dominants. The principal species is *Trachepogon plumosus*, which is quite a remarkable grass. It may be found in flower at all seasons but produces its principal seed crop in November and December. It has a sharp twisted awn that is quite unpleasant for travelers because of its

ability to work its way through clothing. It is grazed fairly well when young but soon develops a harsh leaf and stem and is not then grazed readily. In the more sandy areas it may grow in a nearly pure stand, but is usually associated with other grasses. A species of *Andropogon* is the dominant on localized areas, which is also not highly palatable. These two make up 90 percent of the grasses in much of the upland and are rarely less than 75 percent of the total weight. There is an undercover of smaller grasses of *Paspalum*, *Axoponus*, *Panicum*, *Mesotetum*, and related grasses, which are often different species of the same grasses that are found in the swamps. These make more palatable forage and consequently have probably been influenced by grazing. However fire is by far the dominant influence in the upland plant cover. There may once have occurred species that no longer appear at all.

Sedges also are common on the upland. There are comparatively few weeds and shrubs although there are several species present, especially during the wet season. Some of these are evidently grazed fairly readily. They are more susceptible to fire than grasses and fade out rapidly after the end of the wet season.

FIGURE 1. Typical savannah upland. Building is ranch outstation or line camp. Bunchgrass is *Trachepogon*.

LIVESTOCK AND GRAZING

The upland soils vary from a grey sand to brown sandy loam and are subject to excessive leaching during the high rainfall of the wet season. The deficiency of calcium and phosphorus is severe enough that it has not been possible to successfully raise cattle on upland alone. Failure to recognize these limitations has led to proposals to greatly increase the stocking of the savannahs, which are not at all warranted until this problem has been solved. The lowland and swampy areas hold the water for some considerable period and contain more silt, are

not as much subject to leaching, and have accumulated more of the precious mineral elements. The limited number of analyses made indicate a deficiency even on these lowlands but it is less severe than on the uplands.

Original introduction of cattle in the tropical grasslands was made by early explorers. The first cattle in the Guianas came from these herds well over a century ago, but grazing on the interior savannahs has been an industry of consequence for only 40 to 50 years.

tial numbers of cattle alone would have no meaning.

Original herds were little better than wild cattle and even now are under inadequate restraint or control. Inbreeding is common and has not helped the quality of the animals (Fig. 2). Ranching practice is crude, without fences to control and regulate activities of the cattle. Losses are heavy from a variety of sources including predators, calf crops are low, and animals mature slowly. At present the average steer at five years of age

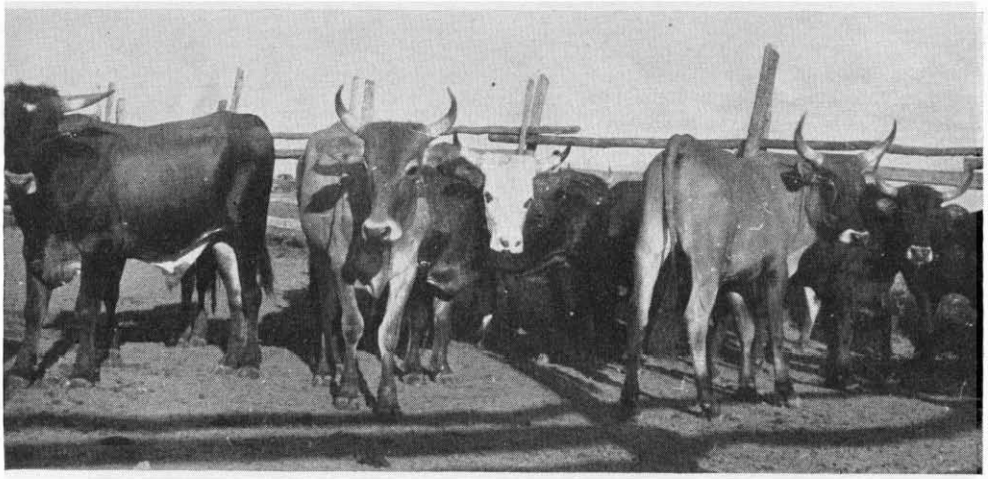

FIGURE 2. Typical savannah steers. Cattle are of light frame and rangy, but are clean boned and of smooth conformation.

The early cattle were Spanish origin, light framed, and slow maturing. However so long as numbers of cattle were low, they thrived and were free of plaguing disease problems. As soon as herds increased beyond the capacity of the lowlands, the quality and health of the cattle degenerated. The present rate of stocking is 15 to 20 cattle per square mile. This is little more than the lowlands will support. The ultimate potential grazing is so interrelated to the correction of deficiencies and with improved management facilities and practices that an estimate of potenweighs 800 pounds although a few in more favored locations as to soil mineral content reach considerably greater weights.

Cattle raising in the wet areas of the tropics has a handicap of disease and parasites although this is not nearly so formidable as has sometimes been thought. Animals develop a remarkable tolerance to the local ailments. Modern science is developing treatments and preventive measures although the work done on specific tropical problems is much less than in the temperate zones, and hence the difficulties are not as well

solved. As a matter of fact the herds in the savannahs were pretty well free of any serious disease problems until comparatively recent times. Ticks are common but not particularly severe. Tick fever is endemic but causes little mortality, although losses in general health and weight of cattle are probably of consequence. Foot and mouth disease has not gained a foothold generally. Many of the diseases of the temperate zone have not occurred at all. Screw worms are a problem and unquestionably do occasion some loss though not generally regarded as severe. Flies of several kinds and mosquitoes are a source of considerable annoyance especially in the wet season.

Ranching and Economic Problems

The ranching industry has experienced a great deal of difficulty in its development. The area is generally isolated and difficult to reach. Transportation is a serious problem. Waterfalls interfere with river transport. Highways and railways are non-existent, and cost of construction through the forests and swamps is well nigh prohibitive. In the early ranching period there was no way to reach the Guiana coast with cattle and no market at all except in Brazil where demand was uncertain and values low.

The market to the Guiana coast was opened with the development of a cattle trail through the forest just at the end of World War I. The trail was very difficult to traverse, particularly in its early years because of the swamps and long distances without feed in the tropical jungles. Losses were extremely heavy and profits small if there were any. This trail is now somewhat improved and death losses are not great but weight loss is severe and only the strongest and most rugged cattle can hope to make the trek. During the depression years of the thirties, cattle scarcely paid the cost of driving them to the market. Ranching has been a moderately profitable undertaking since the more favorable markets during and since World War II.

Since the close of World War II the country has been opened to air traffic. With some aid from the Colonial Government, landing fields have been developed and regular traffic by the Guiana Airways Company established. Beef is now flown out to coastal markets in some quantity. However the cost of this airlift is very high. While present beef values are not high, the airlift is succeeding because the present production costs are very low. It has, however, only partially replaced the difficult and costly trail.

Cattle ranching is carried on with a low capital outlay, but the returns are also low. There are many problems in the transition from the current operation to highly efficient beef producing units.

The problems to solve are only partly contained within the industry. There is a lack of understanding of the industry and its problems by the government. The ranching industry represents only a very small fraction of the population and is not well enough united to be effective in making its needs felt. Ranch operating and marketing facilities are inadequate. Finances are not now available to make needed adjustments. Land tenure is a major problem. The British savannahs are Crown lands operated by the ranchers under a lease. The leases now cost very little but give no satisfactory guarantee of tenure. The ranchers do not feel justified in constructing ranch improvements without more assurance that they will not be dispossessed in favor of native Indians or new settlers.

As in other parts of the Americas, there are a few outstanding characters who figure most prominently in the develop-

ment of the savannahs. The grazing industry was developed and the first markets to the coast established largely by the foresight and courage of a Scotch trader who was able to visualize the commercial potential. The ranch established by this trader has passed into the hands of a corporation. This corporation has been very influential in the promotion of ranching and marketing, chiefly through the interest and activity of its manager, who has pursued his task with great energy. A limited amount of improvement in ranching methods and breeding has been carried on by this concern in spite of tremendous physical and financial handicaps. The local air line is a factor in the economy of the area. Although regular air traffic is recent, the influence on the area is great. Its manager has applied himself to aiding in the problems of the savannah for many years before the task of establishing regular air service was accomplished.

Ranch Improvement Problems

A better quality of livestock is a primary need. A few Hereford bulls were brought in after overcoming great difficulty in transportation shortly after World War I. Zebus or Brahmas were also imported. The crossing of these breeds appears promising. Economic considerations prevented this improvement from being maintained through the depression of the 1930's. The results, while remarkable considering the difficulties and problems involved, have not greatly influenced the cattle breeding. Importations of breeding stock are again being made and breeding of better animals is underway as a modest beginning. A combination of European and Brahman is usually accepted as the most desirable breeding for improving the native cattle.

The savannah grasses are quite deficient in minerals, particularly calcium and phosphorus. These deficiencies must be corrected in some measure before it is possible to accomplish much in livestock improvement. However minerals must be transported inland at great expense, and this makes their use subject to very close scrutiny. Cattle have not been fed common salt up to this time. While addition of salt and mineral supplements can be expected to materially increase meat output, a herd could easily consume more of these products than the present value of the beef produced. A five year old steer will buy less than 500 pounds of salt and mineral. The steer could consume a major part of this amount himself in reaching that age if fed free choice. Ranchers cannot be blamed for being cautious and hesitant to initiate wholesale feeding of the supplements although there is a growing recognition that a program of feeding these supplements on some basis must be worked out.

The question of seeding the savannah to more palatable and nutritious grasses inevitably arises. "There ought to be a grass to plant" is a common remark by visitors. The answer to that question is not a simple one. There are grasses adapted to the tropics which would be a great improvement on the native grasses. Some, as Guinea grass and Para grass, are widespread in the native cover in some sections of South America. Ranchers have made seedings of these and others in small trials. The results indicate success only when fertilized or in a few selected sites. Seeding of small selected areas for special purposes is probably a practical procedure.

Draining and seeding of swamps should improve the forage materially. However drainage possibilities are limited chiefly because there is no practical way to dispose of the excess water for a high percent of the swamps.

Introduced grasses would partially solve the problem of palatability. Some are more productive than most of the native species, but native production is high enough to be reasonably satisfactory. The major problem of mineral deficiencies would not be corrected by new species but only by application of fertilizers. Present indications are that grasses that would make any appreciable improvement require fertilizers. The high cost of application and low value of cattle makes this prohibitive at present.

It is quite possible that tame pasture and hay grasses will eventually become a major phase of ranching. This can come only with cheaper transportation and development of management facilities for the more intensive type of ranching which will be required to handle this type of operation.

The high percentage of relatively unpalatable grasses in the plant cover, the need to protect the more palatable species, the tendency to graze only young, immature plants which requires occasional relief from grazing to permit recovery of grazed plants, all suggest rotation and deferred grazing as an essential measure in the solution to satisfactory use of range.

This means fencing. Fencing is also essential to effecting satisfactory herd control for an improved livestock management program. Fencing is also needed to control breeding animals to make most effective progress in improving the quality of livestock with limited importations of breeding stock. It may be practical to feed minerals on a restricted basis, which will require fencing to control their use and consumption. The average four or five year old steer can be exchanged for about 200 pounds of wire when transportation costs are included. Thus fencing is costly and will likely be installed slowly, but this will to a considerable extent measure progress in improvement.

An additional factor in improvement of range requires checking of the unrestricted burning of the vegetation. Occasional burning may have merit in simplifying grazing use, but the present practice of firing simply because grass will burn can only be wasteful. This is a difficult correction to make because the practice is deeply rooted in the life of the native Indians, who resent any objections the ranchers may raise to their setting grass fires.

The various problems to increased beef output must be met pretty much simultaneously. Livestock quality needs to be improved but cannot be accomplished satisfactorily except as the mineral deficiencies are corrected. To make either of the above profitable, it is essential to have better control and management facilities to help reduce the heavy death losses and generally give the livestock better care. Financing is required from either government or private sources. Improved market facilities are necessary.

The one factor that could be expected to produce rapid enough change to be revolutionary is in transportation. If a rail or truck road could be developed, the cost of shipping livestock out and materials needed into the area would become only a fraction of the present expense, and would be of tremendous significance in changing the area economy. This possibility appears remote at present because of the excessive cost. The indications are that a moderate rate of development is all that can be anticipated. The possibilities of improving the range and of increasing the actual meat output are great, given an orderly development of the needed improvements and ranching practices.

Importance of Grazing Lands in the Agricultural Economy

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A QUARTER of a century ago, the late Dr. C. V. Piper (1924) reported that forage on pastures and range of the U. S. A. provided more than half the total feed requirements of all domestic livestock. There has been a steadily growing realization that grazing lands comprise an important component of agriculture, as a direct source of income, and as the means by which permanently productive systems of agriculture are achieved.

The value of feed produced on grazing lands and consumed directly by livestock has been measured for individual pastures and ranges on an experimental basis at many state and federal stations in the last two decades. Research on improvement of pastures and range has yielded important information which is being put to use in practical agriculture with highly satisfactory results on specific areas in nearly all sections of the country. It is evident that a slow revolution is occurring in the agriculture of the nation, which promises to carry us out of the stage when chief reliance is placed on exploitation of native soil fertility and into an era in which careful management of soil and plant resources will make possible greater returns with less cost and labor on an ever self-regenerating basis.

The rate at which progress will continue to be made in developing the proper place of grazing lands in connection with land use for cultivated and harvested crops, and the place of grazing lands as a permanent type of land utilization, is in large measure dependent on the emphasis which grazing lands receive in funds and manpower allocated for research, teaching, and extension activities. In part, however, progress will depend on the importance given grazing lands by those who determine land policies in legislative and administrative activities, and by the persons and agencies who must finance the changes in agricultural systems. The proportionate allocation of funds and effort may properly be expected to follow the collection of facts showing the importance of grazing lands.

The logical place to seek data on the importance of grazing lands is in the reports by the U. S. Department of Commerce (1943, 1946) of the Agricultural Census of the United States, given in detail every ten years and supplemented by the intervening five-year enumeration. The census is supplemented by the reporting service of the U. S. Department of Agriculture (1950), which produces an annual volume, Agricultural Statistics. A thorough study of these two sources of data soon reveals the inadequacy of data on the production of feed on the grazing lands of the country. Data on grazing lands is limited to a table on land utilization indicating the total acreages occupied by pastures and range, and another table on pasture condition in percent of a hypothetical standard. It becomes necessary, therefore, to estimate the importance of grazing lands by indirect means, on the basis of the net amount of livestock and livestock products which can be credited to feed consumed by grazing stock.

[1] Currently on military leave.

The data on land utilization in the United States is indicated in Table 1. In 1945, land used for grazing totaled 616 million acres within farms, and 292 million acres not in farms (public ownership), making a total of 908 million acres. For all types of harvested crops 403 million acres were reported; these areas including crop failures. The ratio between land use for harvested crops and for grazing was 1 to 2.25. On the basis of this proportional land utilization, it appears that both census reports and annual agricultural statistics, are deficient in not providing a factual basis for determining relative or actual importance of grazing lands in the national economy.

TABLE 1

Land utilization, U. S. A. 1949

	MILLIONS OF ACRES		
	1930	1940	1945
Land in farms			
Crop land	413	399	403
Pastures	379	461	521
Pastured forest and woodland	85	100	95
Land not in farms			
Pasture and grazing (Primary use)	437	382	292
Total pasture and range	901	943	908
Ratio cropland to pasture and range	1 to 2.2	1 to 2.4	1 to 2.25

Grazing lands vary greatly from region to region in their feed producing capacity and their value for support of livestock. In semi-arid and arid regions, the feed producing capacity per acre is lower than in humid regions, and since acreages of grazing lands make up a high percentage of total land utilization in such climatic regions, there has been a tendency to minimize the significance of these extensive land areas. However, the great natural grasslands of the nation occur in regions with subhumid to semi-arid climate, and their total feed value is high. Moreover, it has become increasingly apparent from large scale experiments that management of these grazing lands plays a dominant part in their productive capacity. As it becomes generally realized that natural grasslands require efficient management for continuing productivity, rather than simple exploitation of a natural resource, the need for adequate research and the extension of the findings to practical grassland management, becomes more obvious. In humid regions, the significance of grazing lands and pastures has been rather belatedly receiving recognition and support, but even in these regions, the traditional preoccupation with harvested crops results in a proportionately heavy allocation of funds and effort to the crops. Much of this lack of balance in support of research, extension, financing of grassland improvement may be traced to the absence of comparative data on the significance of grasslands versus harvested crops.

Since direct measures of grassland production are not presently available, perhaps the best estimate available is that derived from the forage supplied to the livestock population. This has been estimated for the entire nation in a single year on the following basis:

Total feed requirement of all domestic livestock *minus feed supplied from crops, milled feeds and concentrates* equals the balance supplied directly by grasslands.

Table 2 shows the total feed requirements and feed sources for all domestic livestock in the United States for 1949. The unit chosen is total digestible nutrients (T.D.N.) and the figures are reported in billions of units. The TDN requirements for maintenance of stock carried through the year plus the TDN required from production of live weights

or animal products sold and slaughtered were calculated on the basis of average TDN requirements reported in numerous feeding trials. Even though poultry and hogs consume a small proportion of the total forage on grasslands, they must be included in this procedure for estimating grassland production by indirect means. Total feed requirement for the livestock listed is 957 billion TDN.

TABLE 2

Total feed requirements and feed sources for livestock, U. S. farms, 1949

REQUIREMENTS (BILLIONS T.D.N.)		
Beef cattle & beef	423	
Dairy cattle & milk	192	
Hogs and pork	199	
Poultry and eggs	58	
Sheep and goats	36	
Horses and mules	49	
Total requirements	957	
SOURCES (BILLIONS T.D.N.)		
All feed grains	293	
Mill feeds and protein concentrates	26	
All hay	99	
All silage	7	
Total harvested feed	425	
Total requirement	957	100%
Total harvested	425	45%
Balance range and pasture	532	55%

The second item in the formula is the total feed nutrients supplied from grains, harvested roughage, and mill feeds and protein concentrates. Feed grains included in Table 2 are: all corn, oats, barley and grain sorghums, and probably are in excess of the amount consumed by livestock by the amounts utilized by industry and for human food. The mill feeds include the by-products of milling and processing wheat, rye, rice and buckwheat as well as the by-products of the feed grains processed for human use. The total feed nutrients supplied by all sources indicated is estimated at 425 billion TDN. This estimate probably is too high, but the error may be neglected in the interest of being conservative as to total feed requirements of livestock satisfied by "grass on the stem."

Table 2 shows an estimated balance of 532 billion TDN required for all domestic livestock, after deducting the nutrients provided in harvested feeds and feedstuffs. Since there is no other evident source of the 532 billion TDN, it is assumed that it was derived by livestock from standing forage on the pastures and ranges of the nation. A conservative estimate, therefore, is that at least 50 percent of all feed requirements for domestic livestock is provided directly by pastures and ranges. If poultry and swine are excluded from consideration, it is probable that the grasslands provide as much as 60 percent of all nutrients for other classes of livestock. It is interesting to note that this estimate is essentially the same as that made by Dr. Piper, a quarter of a century ago.

Since financial support, allocation of manpower to research and extension, and the administrative and legislative determinations of policies for public and private institutions are more sensitive to values expressed in dollars than proportional values, it is of interest to convert the TDN units of Table 2 into monetary units. This is done in the following tabulation:

FEED SOURCES	MILLION DOLLARS
Value of harvested feeds provides 45% of total feed nutrients required	8,714.8
Estimated value of 55% from pasture and range	10,632.0

The total farm values of harvested feed grains and roughage were summarized from the 1950 Agricultural Statistics, and the wholesale values of mill products and protein concentrates were used. The total market value of harvested feeds and feedstuffs available to livestock amounted to $8,715 million. Since this value of feeds accounted for 45 percent of the total feed requirements for all domestic livestock, the estimated farm value for the remaining 55 percent supplied by pastures and ranges is $10,632,000,000. As indicated from foregoing comments, this estimate of the value of forage consumed "on the stem" by livestock is probably too low rather than too high.

The relative importance of total grassland production may be determined by comparing its 1949 value of some 10 or 11 billion dollars with the total value of 17 billion dollars for 72 crops of all types, and 16 billion dollars for value of all livestock production. (See tables 648 and 649, 1950 Agricultural Statistics.) Out of a total of 33 billion dollars, some 10 or 11 billion dollars may be credited to the forage harvested "on the stem" by grazing livestock.

Whatever method may be used for estimating the values of feed produced on pastures and ranges and harvested directly by livestock, two features become apparent: (1) the estimated values indicate this type of asset to be an important portion of our agriculture, and (2) the data collected on this asset are exceedingly meager and inadequate. While it may always be necessary to measure production of grasslands in terms of livestock support, this should be made more accurate by direct reporting of livestock maintenance and production on specific areas and types of grazing land, to parallel the reporting of harvested crop production.

The collection of basic facts on feed produced and utilized on grasslands should not be beyond the capacity of modern procedures for use in census enumeration and agricultural reporting. Methods of evaluating feed-supplying capacity of ranges and pastures are now in use by the federal agencies concerned with administration of federal grazing lands. Methods are being used for the same purpose by the Soil Conservation Service and by the Bureau of Plant Industry of the United States Department of Agriculture. Nearly every stockman and rancher customarily conducts his operations on the basis of estimated feed supply on pastures and ranges. The reporting of actual production arising from feed consumed on grasslands should be less difficult than the prediction of carrying capacity, since it merely involves recording of production facts.

A satisfactory system of determining the value of production on grasslands may be divided into two parts: (1) collection of field data, and (2) treatment of data by the agency concerned, to provide summaries and reduce detailed facts to simplified significant statistics. The collection of field data might well include the following items:

1. Acreage of each class or type of grazing land.
2. Record of livestock maintained and approximate weight changes and livestock products removed for specific periods of the year, for each pasture or range unit. A record of harvested feeds produced elsewhere and given to grazing livestock must be provided for the same land units.
3. The season or seasons when forage production occurred, if different from the period of utilization, should be recorded. This would be valuable information, but not indispensable.
4. Determine proportion of total feed supply consumed by major game animals—deer, etc. This would be

useful information, but not indispensable.

5. Record additional produce harvested from the grazing land, i.e., seed, hay and silage. This item is needed to prevent duplicate reporting of acreage and to permit determination of total production on land units.

The first two of these items are the most important, and initially, the field recording of data might be limited to these. The classes or types of grazing land need not exceed 15 categories for the entire nation, and only a few of these would be found in any one region. These would be analogous to the various types of harvested crops on which yields are recorded. Field data for item 2 will require the cooperation of the operator and enumerator, in much the same manner as for recording field data on harvested crops.

It is not suggested that adequate recording of field data on production of grasslands can be accomplished without additional effort and cost. It is reasonable to expect that collection of field data on this resource that is the origin of about 30 percent of total agricultural income will not only require an appropriate allocation of funds and manpower, but that it will involve additional techniques and procedures not traditionally used in census enumeration and in livestock and crop reporting. The results should warrant the additional effort and expense, by providing a more complete picture of agricultural production than is now provided by a system of reporting in which 30 percent of the total is being neglected.

The feasibility of collecting field data on grassland production (as measured by livestock utilization), should not be confused with subsequent processing of data for publication. The collection of field data should be the primary consideration. Tabulation, summarization, and interpretation will be possible by more highly trained office personnel than is required for field collection of data. The cardinal requirement is the collection of basic field data on production of grasslands. When these data become available, it may be expected that grasslands as a national resource will begin to receive the attention they deserve, in terms of funds and manpower for research, teaching, and extension; in terms of private and public financing of required improvements; and in terms of attention to land policies and the administrative and legislative decisions regarding grazing lands.

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BOOK REVIEWS

MANAGEMENT AND CONSERVATION OF VEGETATION IN AFRICA. By J. D. Scott, D. C. Edwards, F. C. Deighton, R. W. J. Keay, A. Foggie, and J. H. Hinds. 97 pages, 46 illustrations and maps. Bulletin No. 41 of the Commonwealth Bureau of Pastures and Field Crops, Farnham Royal, Bucks, England. 1951. 10/6 net.

This bulletin is a symposium of land management practices, problems and plans covering some of the countries of Africa within the British Commonwealth. The purpose of the bulletin is to show how much the conservation of the soil depends upon the conservation and proper management of the vegetation. Considerable emphasis is given to the need for vegetation surveys and the mapping and describing of the various broad vegetative types using common techniques and terminology in all countries. Information from such surveys is said to be fundamental to future research which is being planned.

The first section of the bulletin deals with South Africa and in reading it you will be struck with the similarity of history and pattern of land settlement and use with that of western United States. Exploitation of the forest and grassland resources was the rule and mismanagement along with the reckless use of fire has caused serious problems with the vegetation and soil. The climate of the country and the land management problems are very much like those of southwestern United States.

Sections II and III discuss land conditions and problems in the countries of Kenya and Tanganyika. These areas have an equatorial climate but with a precipitation pattern ranging from 10 to 100 inches per year. Vegetation varies from desert shrub to equatorial forest. The population of these countries is mostly native, so the first problem in bringing about better land management is to educate the people away from their primitive customs, practices and beliefs.

Sierra Leone and The Gold Coast are small countries on the west coast of Africa where precipitation ranges as high as 300 inches per year. Sections IV and VII describe these countries as populated mostly by peasant farmers who try to make a living growing crops on lands which are naturally heavy jungle. The cultivated areas are shifted constantly since the lands will not produce crops more than two or three years out of ten. Fierce fires burn through these countries each year.

Sections V and VI discussing Nigeria and Anglo-Egyptian Sudan are interesting because the authors attempt to outline some of the ecological changes which appear to have taken place in the different forest and grassland types. Arguments are given to show that the climate has not changed appreciably in the 5,000 to 8,000 years human beings are known to have inhabited these countries and that man and his domestic animals are largely responsible for the ecological changes which have taken place. A list of problems and proposed conservation projects is given for Anglo-Egyptian Sudan.

This bulletin will interest mainly those folks interested in research although it does not present many ideas that are particularly new. Because many of the vegetation and soil problems of Africa are like those in the United States, reading of the bulletin is worthwhile.—*Clark*

E. Holscher, Pacific Northwest Forest and Range Experiment Station, La Grande, Oregon.

GRASSLAND AND GRASSLAND PRODUCTS. By Stephen J. Watson, vii, 200 pp., illus. Edward Arnold and Co., London, 1951.

The main theme of this book is the proper utilization of grassland in the British Isles. The book is well written and covers rather comprehensively the wide field of grassland and grassland management.

Professor Watson points out that the reduction in cost of livestock products is essential to the future welfare of British agriculture, and that proper utilization of grassland herbage is an important factor in attaining this goal.

In brief, the book describes the grassland and its products about as follows: nutrient composition, mineral and vitamin content, feed value, growth and management, natural and artificial drying, ensilage, and its best utilization. All its chapters are well documented by research conducted mainly in the British Isles.

This book should prove valuable to pasture specialists, particularly to those engaged in research work. It should also be of interest to the reader who wants to become acquainted with the work being done on grasslands in Great Britain.—*O. Gordon Langdon*, Southern Forest Experiment Station, U. S. Forest Service, New Orleans, La.

A TREASURY OF WESTERN FOLKLORE. Edited by B. A. Botkin, 806 pp. Crown Publishers, Inc., New York. 1951. $4.00.

This book is truly a treasure chest of source material about the old West. As stated on the wrapper, it is selected: "From all accounts of people who were there when history was made, from tales told around campfires, at roundups and in bunkhouses; from old newspapers and magazines; from forgotten books . . . " Each excerpt or quotation is fully annotated in a footnote reference, so the reader can consult the original document, or know the source if not previously in print.

The book has a wide coverage as to territory, history, and men at work and play. The territory includes all that "marked by the great western tradition," from plains of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, across the mountains to the Pacific Coast. The time covered includes the entire period of white man's activity, from the first explorers and pioneers up to the present. The kinds of men included are soldier and Indian, hunter and trapper, miner and oilman, cowboy and sheepherder, logger and railroader, dryland homesteader and irrigation farmer, gambler and promoter, sheriff and gunman, tenderfoot and dude.

Part One, "The Western Brand," shows what the Westerner is like ("As Big as All Outdoors,") and how he got that way ("A Fresh Deal All Round"). Part Two, "The West Begins," shows how the Easterners came to the West and what they found. Part Three, "Taming the West," recounts the bringing of law and order to the Wild West; Part Four, "The Changing West," covers 100 years of western development. Part Five, "Western Story Tellers," captures the romance of western land and people, and is climaxed with Part Six, "Western Songs and Ballads." Folkways and sayings are interspersed throughout.

The quotations and incidents recounted are brief and highly readable, so that one can open the book at any page to secure

information, reap a spontaneous chuckle, or indulge in nostalgic recollections, as this reviewer did while enroute to and from the 1952 Annual Meeting of the American Society of Range Management at Boise. Each excerpt has a "come-on" title, which makes it difficult to lay the book down. Witness: A Man of Very Few Words, A Man Afoot is No Man at All, Cabin Fever, The Biggest Raise in Poker History, The Englishman on the Range, The Preacher and the Gambler, Sudden Cold, Mule Teams, Horace Greeley's Ride to Placerville, Indian Whiskey, Lost Mine Stories, and so on for some 500 such titles.

Any range worker in need of western folklore, anecdotes, and stories to enliven a speech or a discussion will find this book more than helpful. Range managers, conservationists, teachers, extension workers, writers and researchers—all should have it on tap. The job of finding appropriate material is made easy by two good indices, one of authors, titles and first lines of songs; the second and more exhaustive one of subjects, names, and places.—*R. S. Campbell*, Southern Forest Experiment Station, U. S. Forest Service, New Orleans, La.

THE INTRODUCED MAMMALS OF NEW ZEALAND—AN ECOLOGICAL AND ECONOMIC SURVEY. By K. A. Wodzicki. 255 pp., Dept. of Scientific and Industrial Research, Wellington, New Zealand, Bul. No. 98. 1950. 12/6.

New Zealand is unique in that its flora developed in the absence of herbivorous mammals. Consequently the impact of the introduced mammals which not only feed on vegetation, but also trample it with hard hooves, has been violent. Altogether about 53 species of mammals have been introduced, chiefly by early explorers (to provide meat for subsequent visits) and by colonists. The pioneer settlers of the region felt the lack of a wild meat source and also desired to make the new country as much like the old as possible. This latter wish led to the activities of the Acclimitization Societies which, in the second half of the nineteenth century, introduced wholesale both animals and plants, for sport, utility or amenity value. These introductions seem to have been only feebly opposed by conservationists because the botanists and foresters of the time were generally convinced that the native flora of New Zealand was doomed to extinction and that a new one, based on European species, would replace it. Of all the wild mammals introduced, two of the earliest arrivals, the English rabbit (*Oryctolagus cuniculus*) and the red deer (*Cervus elaphus*) have caused the greatest range damage.

Overgrazing by sheep, along with repeated burning of the grasslands, apparently set the stage for the rapid establishment of the rabbit. It is a burrowing, colonial animal, and, on light soils, especially if the vegetation is already reduced in density, it quickly eats out the more desirable grasses. Rabbit numbers are now estimated at 50 million and adequate control measures have yet to be found. It is interesting to note that like the California ground squirrel (*Citellus beecheyi*), which has similar habits, the rabbit is less numerous on fertilized and well-managed ranges, presumably because of the greater density of vegetation there.

The red deer have spread extensively through the upland forests, destroying the understory, inhibiting the growth of forest reproduction and trampling the plants which carpet the forest floor. The resulting problems in forestry and watershed management are difficult to solve, not only because of a lack of basic infor-

mation concerning the deer but also because of the remote and inaccessible nature of much of the country which it inhabits. Although protection was removed in the State Forest Plantations in 1927 and a bounty actually paid on deer for a while, damage continued. Controls were relaxed in all regions by 1930 and at the present time the deer are killed year-round by forest employees and private hide hunters. But the author doubts that deer numbers have yet been satisfactorily reduced.

Dr. Wodzicki points out that the various administrative moves in the struggle to reconcile the activities of animals and men have been made with a general insufficiency of basic biological information. He emphasizes the fact that much spadework needs to be done before man in New Zealand can expect the maximum economic, sport and amenity returns from wild animal populations at the least expense to soils and plants. As a review of what has been done, a reflection of gaps in the available knowledge and an indication that a basic program of ecological research is underway, this book is an excellent beginning.—*Richard D. Taber*, Assistant Specialist in the Experiment Station, School of Forestry, University of California, Berkeley.

FARM ADVISORY METHODS FOR GRASSLAND IMPROVEMENT. O.E.E.C. 135 pp. Pub. by the Organization for European Economic Co-operation, Paris, 1950.

This book is the proceedings of a Conference on Grassland Improvement, organized by the Ministry of Agriculture for France in co-operation with O.E.E.C., held at the Maison de la Chimie, Paris, May 3 and 4, 1950.

The object of the Conference was to focus the attention of member countries on the potentialities of grassland improvement, and to consider methods of bringing home to farmers the results of research work in this field. Sixteen member countries sent delegates and representatives were present from F.A.O. of the United Nations, E.C.A., I.F.A.P., the Fifth International Grassland Congress, and farmers' organizations and the agricultural press.

Mr. Gabriel Valay, Minister of Agriculture for France, Chairman of the Conference, gave the opening address, followed by two general addresses: "Technological Advances in Grassland Improvement," by Mr. C. Staf, Chairman of the O.E.E.C. Sub-Committee on Agricultural Technology, and "Economic Significance of Grassland Improvement in O.E.E.C. Countries," by Mr. E. M. H. Lloyd, Chairman of the O.E.E.C. Agricultural Production Plans.

Specialists from the agricultural advisory services of member countries described the methods used in their own countries to interest farmers in grassland improvement. Detailed statements were presented by: Mr. Der Khatchadourian, Engineer in Chief, in charge of Fodder Production, France, "Improvement of Fodder Production—Advisory Methods Used in France"; Dr. Ir. H. J. Frankena, Inspector, Division of Grass and Fodder Production, Netherlands, "Difficulties and Possibilities of Putting into Practice the Results of Agricultural Research on Grassland Improvement"; Dr. A. Kauter, Swiss Association for the Development of Forage Crops, Switzerland, "Fodder Cultivation in Switzerland and the Part Played in its Improvement by Advisory Methods"; Dr. T. W. Evans, Provincial Grassland Officer, N.A.A.S. for England and Wales, United Kingdom, "Grassland Improvement and the Advisory Service."

Brief descriptions of grassland advisory activities in their countries were given

by Mr. Segers, Belgium; Prof. Axel Pedersen, Denmark; Mr. D. Hoctor, Ireland; Mr. Sloegedal, Norway; and Dr. Giobel, Sweden.

Technical papers on specific grassland problems were presented by: Mr. R. Mayer, Central Plant Genetics and Improvement Station, Versailles, France, "Lucerne and its Utilization"; Dr. V. Steensberg, Director of the Naasgaard Agricultural High School, Denmark, "Silage and Different Forms of Silos"; Mr. J. Verdeyen, Director of the Section for Grass Production and Cultivation at the Grass and Fodder Research Centre, Belgium, "The Problem of Manuring Pastures"; and Mr. Gwilym Evans, Welsh Plant Breeding Station, Aberystwyth, Wales, United Kingdom, "Seed Production Requirements."

There is a section of general discussion signed with members' names, a closing address by Dr. William Davies, and a list of the delegates.

The studies and findings of these specialists are applicable to similar situations in the United States. The technical papers and the points raised in the discussion entered into by numerous technicians and scientists of member countries are well worth reading by both research workers, administrators, and farmers and ranchers. —*Imogene F. Campbell.*

PASTURE AND FODDER DEVELOPMENT IN MEDITERRANEAN COUNTRIES. O.E.E.C. 176 pp. Pub. by the Organization for European Economic Co-operation, Paris, 1951. $3.50.

During the Paris Conference which is reported in "Farm Advisory Methods for Grassland Improvement" reviewed above, the need was realized for a similar meeting on special problems concerned with pasture and fodder production in Mediterranean countries. In view of the research which has been carried out in the United States, Australia, and South Africa on pasture and fodder production in similar climates, experts from these countries and also from F.A.O. were invited to participate in a survey. The field studies were from March to May 1951 with full co-operation of the agricultural authorities and experts in each country.

The publication comprises three main sections:

Part I sets out the report of the survey carried on in southern France, French North Africa (Algeria, Morocco, and Tunisia), Greece, Italy, Portugal, and Turkey. In a general survey report the Mediterranean environment as a whole is discussed briefly, with attention to climate, rainfall, topography, soils, vegetation, and land use. Then, 28 general conclusions and recommendations needed as a basis for the desired grassland improvement, are listed and briefly discussed. Among these are fundamental meteorological and soils data, ecological and forage value studies, fertilizer studies, seed research, grazing districts, pilot farms, a journal, and a permanent "Mediterranean Grassland Committee."

Part II, the Country Survey Report, is a detailed report on all factors influencing grassland development for each country surveyed. The land tenure system, livestock industry, land classification and use problems, research and advisory work are reviewed. Recommendations are made for research and further study, as well as definite suggestions for present integration of crops, pastures, and livestock, use of fertilizers, testing introduced plants, and adjustments in policy regarding land use.

Part III comprises a resume of the main technical papers delivered at an International Conference held in Rome

to consider the survey report. Papers were given by: Dr. Olaf S. Aamodt, Research Agronomist, United States Department of Agriculture, "What are Improved Pasture and Fodder Crops?"; Prof. Ford S. Prince, Professor of Agronomy, University of New Hampshire, United States, "Influence of Soil Fertility"; Mr. C. M. Donald, Division of Plant Industry, C.S.I.R.O., Principal Research Officer, Australia, "Integration of Pastures, Fodders, Livestock and Crops"; Dr. J. W. Rowland, Principal Pasture Research Officer, Department of Agriculture, Union of South Africa, "Research Methods in the Development of Rotations"; Dr. R. O. Whyte, Grassland and Forage Consultant, F.A.O., "Mountain Resources"; Prof. M. Bandini, Professor of Economics, University of Perugia, Italy, "Technical and Economic Problems Connected with the Increase of Pasture and Fodder Production in Southern Italy"; Mr. Der Khatchadourian, Engineer in Chief in charge of Fodder Production, France, "Farm Advisory Methods for Improving Fodder Production"; Prof. V. Montanari, General Inspector of Agriculture, Venice, Italy, "Farm Advisory Services in Plans for Increased Pasture and Fodder Production"; Dr. Olaf S. Aamodt, "Implementing a Mediterranean Programme for Pasture and Fodder Production"; Prof. B. Maymone, Director of the Experimental Institute for Animal Husbandry, Rome, Italy, "Some Comments on the Mediterranean Survey and Conference"; Dr. William Davies, Vice-Chairman of Conference, Chairman of O.E.E.C. Grassland Working Party, "Summing up of Conference Proceedings."

Resolutions adopted, and list of delegates follow in an Annex.

The report suggests ways and means of increasing production in a vital sector of agriculture by making the best use of the resources already available. It should be read in conjunction with the publication Farm Advisory Methods for Grassland Improvement reviewed above.

Of great interest to farmers, scientists, technicians and administrators, this report is an exhaustive and vital contribution on a subject, until recently, somewhat neglected in Europe. While concerned with problems in the Mediterranean countries, it is equally valuable for all areas with similar climates.—*I.F.C.*

NGUNI-CATTLE: REPORT ON INDIGENOUS LIVESTOCK IN SOUTH AFRICA. Department of Agriculture (Ag. Res. Inst. ser. No. 22) Bul. No. 311. 33 pp. illus. The Government Printer, Pretoria. 1950. 6d.

The data in this report were assembled by a committee appointed in 1947 by the Secretary of Agriculture "to make a survey of the nature and numbers of indigenous stock in this country and to report upon the desirability and means of preserving this stock." Except for the Afrikaner breed, little or no attention has been paid to the improvement or study of the potentialities of the native breeds of cattle in South Africa. European breeds of cattle have deteriorated with a marked decline in their reproductive and productive functions in semi-arid and tropical regions, in some cases even to a level below that of nondescript stock found in these areas. The possibilities of improving native breeds were considered, since the hereditary complex of the animals has been adjusted to the prevailing environmental conditions of the region.

The Nguni cattle study was considered the most important and urgent aspect of the investigations. Data collected on a tour of Swaziland and Zululand, the natural home of this breed, included:

cattle population, description of the environment and of the cattle, and evidence from native stock breeders on adaptability, hardiness, resistance to infection, fertility, and longevity. Wealth and prestige of the native peoples are measured in numbers of cattle they own rather than in the milk or meat the animals produce. Nevertheless with its inherent milking qualities Nguni cattle could be developed into a dairy breed suitable for extensive milk production off the veld.

The conclusion was reached that Nguni cattle constitute the most promising material with which to build up the native cattle industry in the territory. Recommendations were made for ways and means whereby the fullest and best possible use can be made of the pure-bred Nguni cattle still available. The Appendix describes and classifies the breed according to color markings and includes nine black and white, and four color plates illustrating the varied color markings.—*I. F. C.*

GLEANINGS FROM EARLY NEW ZEALAND HISTORY. By J. P. Kalaugher. 108 pp. illus. Unity Press Limited—Printers, Auckland, New Zealand. 1951?

The subtitle "particularly of Auckland and including the Story of the Auckland Agricultural and Pastoral Association, 1843–1950," hints at the context of this little book. Through gleanings from letters, journals, newspapers, and histories in many languages the author tells his story with interesting descriptive tidbits. Besides facts of the discovery, exploration, and settlement of the country there are many quotations giving us impressions of the land by the early travelers, writers, and settlers. Through them we learn of the soils, climate, vegetation, plants and animals introduced, the trials and problems of early farmers and graziers.

The author states that the province even in 1850 contained men of keen observation and great foresight, in quoting from "The Maori Messenger": "The Northern Island of New Zealand is peculiarly adapted for dairy farming. Its pastures arè rich and nutritious in a remarkable degree. There is ample sufficiency of moisture . . . , and we need but point attention to a well-known fact, namely, that the Temaki meadows have throughout the year maintained 100 oxen on 100 acres of ground, to prove the capacity of the country. . . . There is no wealth so natural or so easily obtainable as that of which dairy-farming and sheep-farming may be made the immediate and fruitful source."—*I. F. C.*

THE GRASS, FERN, AND SAVANNAH LANDS OF CEYLON, THEIR NATURE AND ECOLOGICAL SIGNIFICANCE.—By C. H. Holmes. 95 pp., illus. University of Oxford, Imperial Forestry Institute. Inst. Paper 28. Oxford, 1951. 20s.

Despite his multifarious and exacting duties as a Forest Officer, Dr. Holmes has found time to make a detailed study of these lands extending over a number of years, according to the preface by F. White, Forest Botanist, and H. G. Champion, Professor of Forestry, Imperial Forestry Institute, Oxford.

The origin and status of Ceylon's grasslands have long been a controversial subject. By applying to Ceylon the systems of climatic analyses devised by Thornthwaite and by Swain, Dr. Holmes deduces that a closed forest is the natural climax. Yet widespread throughout the country are formations, seemingly permanent, of savannah, grasslands and fern-

lands. In his careful study of these lands Dr. Holmes has found that all these types are definitely secondary and of biotic origin, arising from clearing, burning, and cultivation, and later after abandonment, by periodic burning.

Seven distinct major classes of these formations are listed. For each formation he assembled historical, archaeological, and even philological evidence, and examined climatic and soil conditions and data. The structure and floristic composition of each climax type of forest as well as that of the grass, fern or savannah lands associated with it is described. Ecological evidence regarding the nature and origin of the grasslands is presented.

The book is interesting and well organized. There are 47 literature citations and 29 illustrations. A map shows the distribution of the vegetation types and an Appendix lists the plants under each type. This book should prove useful to all those concerned with afforestation and anti-erosion work in upland regions of tropical countries.—*I. F. C.*

BRIEFS

Friendship is the cement that will hold the world together.—*Woodrow Wilson.*

After all there is but one race—humanity.—*George Moore,* in The Bending of the Bough.

Our true nationality is mankind.—*H. G. Wells,* in The Outline of History.

Friendship is equality.—*Pythagoras.*

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NEWS AND NOTES

Grassland News

The following items were gleaned from the Grassland Newsletter issued by the U. S. Department of Agriculture, Land-Grant Colleges, and Cooperators, in support of the National Grassland Program. The Letter serves as a means of exchanging ideas for improving and accelerating the grassland program by calling attention to the latest developments in research, techniques in promoting grassland improvement, events of interest, and progress in State grassland programs.

Grass Revegetation and Reseeding

The Great Plains Agricultural Council has collected data from 402 county agents showing that a total of 1,150,000 acres were returned to grass by revegetation and reseeding in 1951 as compared with 847,000 acres in 1950. Most of this conversion took place in North Dakota, South Dakota, Nebraska, Texas, and Oklahoma.

More Beef

If 230 million acres of this country's open grassland and an additional 70 million acres of abandoned and submarginal cropland were converted to improved pastures, they could produce an additional 10 to 15 million *tons* of beef . . . more than double the present annual beef supply for the whole country. . . . Our grassland provides the largest undeveloped potential for increased production in the United States. Unless we have greatly accelerated research soon on . . . the grassland problem, the ultimate potentials of our Grasslands Program cannot be realized.—*W. M. Myers.*

Penn State Grassland Field Days

Pennsylvania State College conducted a series of Grassland Field Days from May 22 through June 5, 1951. The series covered everything from seed treating to sheep shearing and had a total attendance of 26,000.

Kentucky Green Pastures Program

More than 2,600 farmers took part in this program in 1950 and 3,200 in 1951. The State is divided into 16 "Green Pasture" districts and one farmer is selected from each district for recognition as Kentucky District Master Pasture Man.

Wyoming Grassland Improvement Year

Governor Frank A. Barrett has proclaimed 1952 for this program and has appointed a State Grass Committee consisting of representatives of farm organizations, State and Federal agencies, various private concerns, groups, and interested individuals.

"Better Grass for Better Farm Living"

A large share of the January 19 issue of The Ohio Farmer was devoted to this subject. This one issue contained 11 articles on as many phases of grass, pasture, or forage.

Range and Pasture School

The College of Agriculture, University of California, sponsored a range and pasture school in February, at Berkeley.

Grass and People

The Annual Grassland Caravan sponsored by the Montana Extension Service used this theme in its visit to 24 coun-

ties. Exhibits showed how grass and legumes fit into farming in Montana.

Range Management Course

The University of Wyoming conducted a Range Management Course at Laramie in February, covering range and meadow improvement, plant utilization, weed control, and grazing policy.

Grassland Research Urged

Livestock and seed committees, which operate in an advisory capacity under the Research and Marketing Act, at meetings with USDA officials in February strongly urged that more emphasis be placed on grassland research. "Research to improve forage for livestock should be given top priority," the livestock committee said, "so that production of meat and meat products can be increased." Research should also seek better methods for controlling weeds, shrubs, and brush on range lands, the committee believes, and more attention should be given to the bloat problem which is a deterrent to grassland farming.

Among recommendations submitted by the seed committee are these: Emphasize work on improvement of grasses and legumes, particularly legumes that are adapted to the dry-land Great Plains areas and the deep South; and expand current work on the development of improved cultural and management practices for producing seed of forage grasses and legumes to include studies of both injurious and beneficial insects.

Bloat Problem Discussed

The potential seriousness of this problem and how it might be licked was the purpose of a special meeting in Chicago during the week of the International Livestock Exposition. Several management systems were suggested at the meeting to help prevent acute bloat.

4-H Club Range Management Camp

This camp was held for older 4-H Club boys in June at Camp Wooten, Washington.

California Grassland Tour

The California State Coordinating Grassland Tour started in Sacramento County on May 5 and ended in San Joaquin County two weeks later.

"Green Promise"

This is the title of a recent film production of the New Holland Machine Company, New Holland, Pennsylvania. This is another example of interest and help on the part of industry in promoting grassland improvement.

Grassland Handbook

The why, when, where, and how of profitable grasslanding with livestock is the theme of The Grassland-Livestock Handbook recently issued. The answers to 104 questions are found in this handbook issued by the Joint Committee on Grassland Farming under a grant-in-aid from the Committee on Agriculture of the American Petroleum Institute. It is an up-to-date version of the Committee's first publication, "Green Fields are Gold," of which a quarter of a million copies have been distributed in the past five years.

Forage Crop Leaflets

The Oklahoma Experiment Station at Stillwater has started a new series of leaflets, four of which were published in January. It expects to issue a total of 30, one each on the more important grasses and legumes and on all phases of grassland management.

New Kansas Pasture Publication

The Fort Hays Branch of the Kansas Agricultural Experiment Station has issued Circular 276 entitled "Grass Utilization and Pasture Management Investigations for 1946–1950."

Grassland Farming

This was the featured theme at the 49th Annual Convention of the Association of Southern Agricultural Workers at Atlanta, Georgia, in February.

New England Green Pasture Program

The January 26 issue of the New England Homestead was mainly devoted to grassland farming, particularly to the Green Pasture Program which the Homestead is helping to sponsor. In the Green Pastures Contest of 1951 M. V. Corey of Middletown, Rhode Island won the coveted award over 3,481 other farmers.

Oregon "Grass is Gold" Contest

An editorial in the February 17 issue of the Sunday Oregonian pays tribute to the "Grass is Gold" contest, sponsored by the Portland Chamber of Commerce. It quotes Extension Agronomist E. R. Jackman this way: "Only 8 percent of Oregon's land is arable, the rest is timber or grass producing. The State's farmers have arrived at a high state of productivity in other crops; the great opportunity for agricultural improvement lies in producing more and better grass."

Bermuda Grass in South Carolina

In pasture tests at Clemson, South Carolina, Bermuda grass led all other grasses in carrying cattle. Where grazing was rotated and a good reserve of summer and fall growth carried into the winter, beef cattle did well on it until Christmas time. After Christmas the herds were turned on grazing crops consisting of small grains, fescue, and ladino clover which carried them until April when the Bermuda was again ready for grazing.

Virginia Pasture Improvement Program

This Program was recently given more impetus by the contribution of $125,000 to the VPI Educational Foundation from the Old Dominion Foundation, of which Paul Mellon of Upperville, Virginia, is president. The funds will be used for research on grasses and forage crops.

THE INTERNATIONAL CATTLEMAN

We welcome to the range the new publication, "International Cattleman", published monthly by the International Cattle Publications, Inc., Houston, Texas. Volume 1, Number 1, was issued January 1952. This beef cattle journal is dedicated to Gulf Coast and Pan-American cattle breeding and pastures. It appears well fortified with advertising and with illustrated articles designed to appeal to producers of all beef cattle breeds. The early issues feature "Green Fields are Gold", a section of questions and answers on grassland farming. Tom Alexander is General Manager, and John H. Murphy is Editor.

NATURAL RESOURCES COUNCIL MEETING

The Natural Resources Council, consisting of 36 member organizations, held a special meeting on March 16, 1952, just prior to the 17th North American Wildlife Conference in Miami, Florida, regarding the Policy for Renewable Natural Resources. This policy was adopted at the fifth annual meeting of the Council on October 1, 1951, and was subsequently endorsed "in principle" by 21 member organizations, including the American Society of Range Management. At this

meeting there was much discussion of various sections of the policy, involving editing, principles, as well as some opposition to certain sections, particularly Section 9, which recommends an independent board of review. Delegates who did criticise the statement also welcomed the fact that the various societies interested in conservation had finally gotten together at least to this degree on a natural resources policy.

Committee on Plant and Crop Ecology

On March 22 and 23 in Washington, D. C., the new Committee on Plant and Crop Ecology of the National Research Council had its first organizational meeting. There were six subcommittees: Aerobiology, Agroclimatology, Conservation, Crop Geography and Vegetation Analysis, Plant Crop Yields, and Plant Diseases and Pests. Tentative outlines of programs were formulated. The chairman of this committee is Dr. Ralph E. Cleland, Indiana University.

North American Wildlife Conference

The Wildlife Management Institute reports an attendance of about 1,000 people at the 17th Conference, held in Miami March 17 through 19. Fish and game administrators, leaders of national conservation organizations, biologists, sportsmen, and prominent legislators and other figures in public life came from Alaska, Canada, Mexico, the Virgin Islands and from nearly all the states in the Union.

An important national natural resources policy was presented at a general session of the Conference presided over by the Honorable James H. Duff, U. S. Senator from Pennsylvania, assisted by the Honorable Clark W. Thompson, U. S. Representative from Texas. The sweeping policy, which covers the management and restoration of all renewable natural resources, including soils, waters, forests, and wildlife, was presented by William Voight, Jr., chairman of the Natural Resources Council of America and executive director of the Izaak Walton League of America.

Shortcomings in the conservation program were treated in the opening general session. Cleveland Van Dresser, West Palm Beach radio commentator and author, reported that antiquated mining laws are robbing the American public of alarming segments of its public lands. The need for zoning the wilderness areas was discussed by Dr. W. J. K. Harkness, Chief of the Division of Fish and Wildlife in the Ontario Department of Lands and Forests.

The important role of insects and diseases in limiting forest production in the United States was reported by Lyle F. Watts, Chief of the U. S. Forest Service.

U. S. A. Scientists Abroad

Approximately 500 agricultural scientists and technicians of the United States are now engaged in technical cooperation activities in other countries, according to a summary recently made by Dr. M. L. Wilson, Director of Extension, U. S. Department of Agriculture, before a United Nations group. "We should also remember that sending Americans abroad is only one part of the technical assistance program," Director Wilson said. "Another important part is in bringing people here to study our agriculture. . . . This year the United States Department of Agriculture will handle about 3,300 foreign visitors in the field of agriculture. These do not include the many hundreds of

foreign students studying in our agricultural colleges. . . ."—Foreign Agriculture, March 1, 1952.

Greek Forester Praises U. S.

Excerpt from letter to W. L. Dutton from Panos Margaropoulos, Greek Forester, following latter's visit to the U. S. on a study of range management techniques and practices:

"This visit in your country will remain in my memory a long time; it was profitable not only from the technical training standpoint, but also for this excellent opportunity to attend your way of discussing technical problems before placing them into action. This meeting at Manitou, last August, will remain unforgettable in my mind. I was extremely impressed not only with the topics under discussion but also with the atmosphere of democracy that prevailed among the participants in exchanging their ideas. This procedure of discussing Administration and Research topics before placing them into action is unknown in most of Europe."

Johnson to Phillipines

Ray G. Johnson resigned as Range Management Specialist with the Montana Extension Service upon appointment as Agricultural Production Officer with the Mutual Security Agency in the Phillipine Islands. Karl Parker, formerly County Agent for El Paso County, Colorado has been appointed to replace Johnson.

Chohlis in New Position

G. John Chohlis, formerly Range Conservationist with the Soil Conservation Service, at Yakima, Washington, resigned his position in April to enter new work. He is now field representative for the Western Livestock Journal. He will work with registered breeders in northern California, Utah, and Nevada, and do editorial work for Crow Publications—WLJ, Western Dairy Journal, and Farm Management.

Ellison Tells of Work in Australia

Dr. Lincoln Ellison (Linc to many of us) has just resumed his work in charge of range research at the Intermountain Forest and Range Experiment Station after spending part of the past year in Australia on a Fulbright Fellowship.

He spent about half of his time visiting research centers in New South Wales, South Australia, Victoria, and Queensland. This gave him an opportunity to meet most Australian ecologists and many workers in related fields, as well as to get a broad cross-section of pastoral problems and research being done on them. Everywhere he met with the greatest kindness and consideration.

The range country, called 'native pastures' has grasses like our prairies, and saltbush types roughly comparable to salt-desert shrub. In general, manipulation of livestock is discounted in such country as a means of pasture improvement, although Australians are cognizant of the effects of abusively heavy grazing in terms of soil erosion, particularly by wind. It is felt that management is a minor influence in comparison with rainfall deficiencies, kangaroos, and rabbits. Distribution of the stock is a major problem because of costs in developing water, and as with us considerable country is grubbed near water supplies while equally good grazing land a few miles away is untouched.

The latter half of Linc's stay was spent in a study of environmental relations of vegetation and soil in southeastern Queensland. Located within 100 miles of Brisbane, this area provides oppor-

Stoddart

W. T. White

A. L. White

J. H. Christ

Fulton

Atkins

Vaught

Christensen

McBride

Johnson

Photos by Mary Ann Fulton

tunities to observe a variety of vegetal communities, from rain forest to grassy plains and from coastal swamp to many kinds of eucalypt forest. These correspond with a variety of climates and soils, so that the area is really a great ecological laboratory. The Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization, which sponsored Linc's visit, provided him with a car for official use and with laboratory, office, and library facilities. One of the young ecologists in the Division, E. J. Coaldrake, collaborated with him in his research. Choice of subject matter and procedure was left entirely up to him, but he had most helpful counsel from Dr. J. Griffiths Davies, Assistant Chief of the Division, who is known to many range and pasture workers in the United States. The bulk of the cost of the fellowship is of course borne by the Fulbright grant, derived from sale of surplus U. S. Army equipment in Australia after the war.

In a belt 200 to 300 miles wide the rainfall of eastern Australia is adequate for intensive pasture development. Here emphasis is directed primarily toward finding suitable species for pasture improvement and amendments necessary to correct the widespread, complex mineral deficiencies of Australian soils. Considerable effort is also being devoted to ecological surveys, particularly in the drier and otherwise marginal areas. The end result of these surveys, truly a pioneering scientific effort, will very probably be an extensive knowledge of native vegetation which can be equalled in few countries at the present time.

Reclaiming Sagebrush Lands by Roto-Beater Method

Several ranchers in southern Idaho are using the roto-beater to clear sagebrush.

J. O. Beck, developer of the new Sevelra alfalfa seed, used the roto-beater once over, followed by offset discing to prepare his range for seeding. Jack Henley, cattleman, is clearing a large acreage for range reseeding, planting pubescent and intermediate wheat grass, russian wild rye, and common and ladack alfalfa. Harvey and Ralph Groefsema are beating off sage land to reclaim for row crop use. On the Bennett Brothers Ranch in Little Camas area, and Carl Nicholson Ranch adjacent to Boise, the range is being cleared of sage by beating to release native grasses.

South of Nampa, Idaho, near the Snake River Kenneth and Donald Tiegs are each clearing a section (Fig. 1). They have drilled their own wells for irrigation and plan to put the land into row crops and grain. The practice of reclaiming sagebrush lands by the roto-beater method has taken on considerable impetus during the past year with the development of a heavier model for this work.—*Ray F. Blair.*

Ex-Treasurer Relaxes

Former ASRM Treasurer Ken Pearse remarks: "Life is sure wonderful—no bills to mail, no cards to sign, and no kicks to answer!"

Visitor from Pakistan

Mr. Jamil R. Shairani, Divisional Forest Officer from Pakistan, had the distinction of being the Society member farthest from home at the Annual Meeting in Boise. He showed two reels of movie film there, depicting the life and customs of his home country, which was partitioned from British India in 1947. Mr. Shairani is charged with the administration of the bulk of State Reserves in the province of Baluchistan, where a large proportion of

the land is grazed by sheep and goats, much as were our public domain lands in the days of free grazing. Range management, as such, was an unknown science in undivided India, but is now attracting due attention in Pakistan, according to Mr. Shairani. Centuries of unrestricted grazing use have left Pakistan ranges largely denuded of vegetation and soil cover.

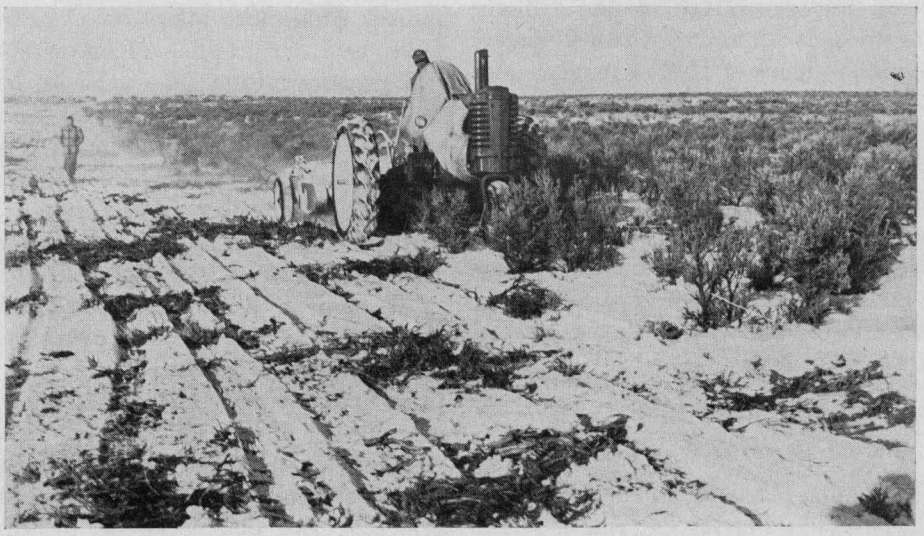

FIGURE 1. TIEGS BROTHERS CLEARING TWO SECTIONS OF LAND SOUTH OF NAMPA, IDAHO, FOR ROW CROP PURPOSES, USING OLSON ROTO-BEATER

Mr. Shairani is studying range management at the Utah State Agricultural College, School of Forestry, for one year under the Point 4 program. His previous academic training includes nearly four years at Forman Christian College, Lahore, and 24 continuous months at the Imperial Forest College, Dehra Dun, India. He plans to spend the summer season visiting range projects in the West, and will return to Pakistan in early fall, 1952.—*Grant A. Harris.*

DR. BEETLE COLLECTS PLANTS IN SOUTH AMERICA

Dr. Alan A. Beetle, Range Management specialist, University of Wyoming, is on leave while plant collecting abroad. He holds a temporary post with the Plant Exploration and Introduction Section of the U. S. Bureau of Plant Industry. He spent several weeks at Beltsville, Maryland in preparation for the trip.

He will travel the length of Argentina and Uruguay collecting grasses and legumes in a climate similar to the Northern Great Plains. Forage plants of possible value to North America will be investigated. In a letter dated March 23 he said that he had already been in Patagonia and that week was flying back for two more weeks of collecting before winter settled in. He says that Argentina is suffering from a severe drought and that overgrazing, together with the drought, is creating a problem in that country.

He reports that a great deal of interest in Range Management is evidenced in Argentina. Since the Journal of Range Management was unknown he has sent for copies to exhibit as he travels about, hoping to interest libraries and individuals in subscriptions.

Burzlaff as Instructor at Wyoming

Donald F. Burzlaff is serving as instructor in Agronomy and assistant in Range Management in the Agricultural Experiment Station at the University of Wyoming during the absence of Dr. A. A. Beetle. Burzlaff graduated from the University in 1950 with major work in botany and fungi. Last year he was Acting Superintendent of the Gillette substation in Campbell County during the miliary leave of L. R. Landers.

Reed Returns to Wyoming

Dr. John Reed, associate professor of botany, University of Wyoming, has returned to his post on the campus after a year's leave of absence to participate in a soil analysis and classification project in the Congo.

Growing Beef in South Australia

In the first place the production of beef as a by-product of the dairying industry can be increased mainly by better all round attention to the herds, so that from birth to final disposal all animals are well nourished and grown and carry satisfactory condition. Half the consumable beef in South Australia comes from this source. . . . Secondly, in the good rainfall country of the southeast and south of the State there is still much scope for further beef production by development of lands which are either still undeveloped or under-developed, by carrying cattle on those properties where there are none at present, by studying the methods of sheep-cattle grazing management so that an optimum ratio will be reached according to the property, and by breeding specifically for economy of fodder consumption and for quality. The present contribution of about 3000 tons of beef from this source could be stepped up considerably and could be of the highest quality.

Thirdly, in the semi-arid country there seems but little scope for cattle on properties devoted to sheep. On those devoted to cattle, more waters, separation of cows with calves and cows in advanced pregnancy from other stock, segregation of young heifers by keeping them in the bullock paddock or otherwise away from bulls, and the breeding of better cattle can produce results. The scope is, however, severely limited by the erratic nature of the climate, so that, although appreciable gains can be made, they will not be spectacular. Fourthly, in the agricultural areas there is an important field for study of the questions both of grain feeding and of the use of cattle in rotations. South Australia is particularly favourably situated for such studies and it is of considerable importance to her considering her limited area of good rainfall country. The State is, moreover, favourably situated geographically, strategically, and defensively in regard to both export and domestic trade in beef, so that development a long these lines, if feasible, would be of importance also to the neighbouring States and the Northern Territory and, consequently, to the Commonwealth as a whole.—*W. A. Beattie* in The Pastoral Review and Graziers' Record, October 16, 1951.

Platt to Egypt

Kenneth B. Platt, Bureau of Land Management, Washington, D. C., has been assigned for one or two years to Cairo, Egypt, as a Land Management Specialist under TCA. He will work with the Egyptian Government on problems of land tenure and distribution. He is

completing his three-year term as a member of the JRM Editorial Board.

In Memoriam

The farming and ranching industry of South Texas lost an outstanding leader in the death of E. L. Caldwell, Sr., Corpus Christi, in September, 1951.

Mr. Caldwell was born in Corpus Christi November 7, 1871 and was educated at Purdue and Cornell, where he studied agriculture and its problems. He entered the hardware business with his father and as he traveled widely throughout the Coastal Bend and the Rio Grande Valley, he became known to most pioneer ranchers and farmers.

Following the 1919 tropical hurricane which devasted the downtown section of the city he entered business for himself, at first featuring cypress cisterns. Caldwell made his most impressive contribution to South Texas agriculture by designing and manufacturing equipment for farm and ranch operations. He designed and manufactured steel rollers to replace the crude wooden rollers used by farmers to pack seed beds, when cotton was coming into its own as a major crop in the Coastal Bend. A pioneer in pasture improvement, he was among the first to sense the seriousness of the encroachment of brush on pasturelands. From a cutter he developed for cotton stalks, he visualized a heavier piece of equipment for cutting brush on pasturelands. He continued to improve his brush cutter, keeping pace with the development of power equipment capable of pulling heavy equipment. Request for his cutters came from Africa, South America, Mexico, and even as far away as Australia.

Caldwell spent a great deal of time corresponding with government officials and agricultural leaders in foreign countries, advising them on methods of meeting their problems and improving their agricultural and ranching methods. During the last few years of his life he had literally become an international figure.

A student of agricultural problems for more than three score years, he knew the needs of this area as fully and completely as any other person identified with the agricultural economy of South Texas.—From the Corpus Christi Caller-Times.

WITH THE SECTIONS

SECTION OFFICERS

Section	*Chairman*	*Vice-Chairman*	*Secretary*
Arizona	Matt Culley Box 56B Sahuarita	John D. Freeman Soil Conserv. Serv. Prescott	Ben Nelson Forest Service Phoenix
California	Donald R. Cornelius Calif.F. & R. Expt. Sta. Berkeley	Alfred H. Murphy U. C. Range Field Sta. Hopland	Arnold Schultz Univ. of Calif. Berkeley
Colorado	L. E. Riordan Colo. F. & G. Dept. Denver	Neal P. McKinstry Soil Conserv. Serv. Briggsdale	Lloyd Bruce Bur. Land Mangt. Denver
Kansas-Oklahoma	Lester R. Branson Prod. Mktg. Adm. Manhattan, Kans.		Robert C. Pickett Kansas State Col. Manhattan
Idaho	Liter E. Spence Univ. Ext. Serv. Boise	Jerome Evans 1515 N. 11th Boise	Robert Officer 2805 Palouse Boise
Nevada	E. R. Greenslet P. O. Bldg. Reno	Joseph H. Robertson Univ. of Nevada Reno	John M. Fenley Box 111 Paradise Valley
New Mexico	Francis A. Riordan Box 1695 Albuquerque	Arnold Heerwagen Box 29 Raton	F. M. Hodgin Box 1310 Albuquerque
Northern Great Plains	Bruce Orcutt Beaverslide Ranch Miles City, Mont.	E. J. Woolfolk Forest Service Missoula, Mont.	F. A. Branson Mont. State College Bozeman, Mont.
Northern International Mountain	W. R. Hanson Calgary, Alberta, Canada	A. C. Grande Lennep, Mont.	Ed Burles Calgary, Alberta, Canada
Pacific Northwest	Floyd Iverson Forest Service Portland, Oreg.	Leon Nadeau Bur. Land Mangt. Portland, Oreg.	Joe T. Fallini 5135 N.E. Ainsworth Portland, Oreg.
South Dakota	Carl Ham Caputa	Francis E. Murphy Flying V Ranch Hermosa	Henry Holzman Extension Serv. Rapid City
Southern	John T. Cassady P. O. Box 1192 Alexandria, La.	W. G. Kirk Range Cattle Expt. Sta. Ona, Florida	R. E. Williams 623 W. 11th St. Crowley, La.
Texas	H. L. Leithead Box 1112 Marfa	Roger Q. Landers Menard	Leo B. Merrill Texas Expt. Sta. Sonora
Utah	Albert Albertson Forest Service Cedar City	A. Perry Plummer Int. F. & R. Expt. Sta. Ephraim	Max Robinson Branch Agr. Col. Cedar City
Wyoming	Don Wilbert Soil Conserv. Serv. Riverton		L. H. Rasmussen Box 92 Tensleep

Arizona

Brush burning and rehabilitation of the browse ranges of Arizona were the main topics of discussion at the June meeting of this Section. Among the prominent speakers were Cecil Miller, Arizona rancher; Joe Wagner, Indian Service; and a representative from the brush burning experiments in California.

Idaho

At a short business meeting held on January 31, 1952, during the Annual Meeting of the Society, it was decided that this Section would attempt to publish a newsletter to be circulated among the Section members. This letter will contain items of interest to the members such as meetings, field days, and news about members and their activities in connection with range management. The first letter was published March 17.

Society members in eastern Idaho met on March 22 at Idaho Falls to lay the ground work for the organization of an Eastern Idaho chapter.

In June this Section sponsored a range field trip to demonstrate progress in seeding five new range grasses sown in alternate rows with four varieties of alfalfa and yellow sweet clover. Long yearling steers were grazing this area, which is private range land. Results of various commercial fertilizers on reseeded and native grass areas highlighted the yield studies. A roast turkey dinner, and a floor show on Sage Brush Removal with a Roto-beater followed.

Kansas—Oklahoma

A winter meeting of this section was held at Hutchinson, Kansas, December 7, 1951. A paper by L. C. Aicher on the "History of Grass Seed Production at the Fort Hays Experiment Station" was given by A. J. Casady. A ten acre field of buffalograss was described that produced from about 200 to 600 pounds seed per acre for 7 years with a drop to 11 pounds in 1950 and somewhat less in 1951, which were the two wettest years in recent history. Sideoats grama seed production also varied greatly during the 1940's.

Don Atkins, S.C.S., Manhattan, talked about "Processing seed of chaffy grasses". Operations were described such as scalping mixed bluestem for 3 cents per pound. About 20 percent by weight was removed and 164 pounds of seed turned out per scalper hour. Cleaning such grass by fanning mill and hammer mill in sequence cost from 5 to 7 cents per pound. Such operations are not profitable for commercial concerns as long as demand for non-processed seed is good for use in grass drills.

George Atwood, S.C.S., Elkhart, gave a report on seeding 84,000 acres. His opinion was that the big problem on native grass seed is production. Harvesting and processing improvements are needed but the present methods will do for present seed production.

Andrew Riegel, Fort Hays State Teachers College, gave information about "Ecology of Grass Seed Production". He stressed the fact that native grasses that are the most undependable in seed production are the most vulnerable to fluctuations in environment.

"Sudangrass seed production in Kansas" was discussed by R. C. Pickett, Kansas State College. The serious defects of present commercial varieties were discussed with the development of new Kansas varieties described.

Pat McIlvain led a panel discussion (argument?) on *introduced vs. native grasses*. Four stalwart men were selected for each side. With Pat's able assistance,

the introduced group won. There was general agreement that native grasses will be with us for some time. This was the high point for open discussion.—*R. C. Pickett.*

Pacific Northwest

The third annual meeting of this Section was held at Baker, Oregon, on November 1 and 2 with an attendance of over 130 people. Forty-two new membership applications were received during the meeting giving some indication of the growing interest in the activities and aims of the Society.

The arrangements and program committee chairmanned by Ira Stagges and Alan Rogers, leading ranchers in Oregon and Washington, did an outstanding job, contributing materially to the success of the meeting.

Chairman E. R. Jackman gave his annual address at the morning session.

Alan Rogers was the main speaker at a noon luncheon session and Dan Fulton, Society President, gave an interesting presentation at the evening banquet on the subject entitled "Where Do We Go From Here."

Clark Holscher, Research Forester for the Pacific Northwest Forest and Range Experiment Station, ably covered the subject of "What's Going On In Range Research," explaining progress and results of various studies in the Pacific Northwest pertaining to range management practices, reseeding, forage values and animal nutrition. The committee on range research of which Holscher is Chairman submitted a list of problems which they feel require further research.

The phase of irrigated pasture and range and livestock management was discussed by Arthur E. Miller, Soil Conservationist, Soil Conservation Service. Proper management practice applied to irrigated pastures in Kittitas County, Washington, produced remarkable results in gains of livestock, net returns and increased valuation of property. A demonstration pasture in the Kittitas County Soil Conservation District produced 600 pounds gain on cattle at a cost of a little over 7 cents per pound. The assessed value of property in the county increased this year by $1,500,000, most of which was due to more cattle on irrigated pastures.

Tom Willis, Superintendent of the Dominion Range Experiment Station, presented an excellent paper by M. A. MacDonald, on pine needle abortion of range beef cattle. Results of experimental work at the Station indicate that pine needles and buds of the western yellow pine (*Pinus ponderosa*) are causative agents of abortion and the birth of weak calves in range beef cattle.

Newell Dickson, Grazing Specialist, Western Washington Experiment Station, spoke on forage seeding trials on logged-off lands in western Washington. Species showing the most promise included orchard grass, alta fescue, tall meadow oats, rye grasses, turf grasses and subterranean, white and alsike clovers. The slump in forage production following a few years of good growth can possibly be explained by depletion of available plant food. Limited studies indicate that the production period of these plants can be lengthened by application of fertilizers and the presence of legumes in the mixture.

O. S. Weaver, Range Specialist, Cascade Lumber Company, discussed range management on private timber lands. The management and improvement problems are complicated by the checkerboard land ownership pattern and the primary use of these lands for timber production. The management practices

on adjacent lands largely influence the management and improvement programs that can be carried on these private lands.

Range management on the Central Oregon LU project was the subject of discussion by W. F. Currier, Project Conservationist, Soil Conservation Service. He gave the history and background of the project, objectives of the range management program, and means of measuring the effectiveness of the range program through conservation surveys and utilization checks.

Range management on grazing districts by Howard DeLano, Range Manager, Bureau of Land Management, dealt primarily with ways of accomplishing good range management through the establishment of individual allotments of Federal range wherever practicable.

Robert S. Rummell, Range Conservationist for Pacific Northwest Forest and Range Experiment Station, explained the advantage and disadvantages of cheatgrass, and summed up with the statement that, "Perennial grasses do a better job on range lands in the Pacific Northwest."

"Does Reseeding of Range Lands Pay," by C. V. Plath, Department of Agricultural Economics, Oregon State College, outlined various reseeding operation costs and what returns can be expected. Mr. Plath wound up his discussion by saying that, "Range reseeding does pay if proper sites are selected, a good job of reseeding is done, followed by a good management plan for both range and ranch."

During the business session several committee reports were presented. Newly elected Council Members are Thomas C. Willis and R. A. Long. Other Council Members are: Frank Lenzie, Woodward Bohoskey, Gerald Stanfield, Maurice McGregor, W. C. Pendray, and E. R. Jackman.

Leon Nadeau, Chairman of the Halogeton Committee, reported that under an educational project sponsored by the Pacific Northwest Section, Oregon State College and the Bureau of Land Management prepared and distributed 900 Halogeton mounts to various county, State and Federal agencies and educational institutions.

Tom Willis, Chairman of the Summer Tour Committee, reported on the grassland and livestock improvements observed on the summer tour over Whitman County, Washington. Willis on behalf of the British Columbia members invited the Section to hold their 1952 tour in British Columbia.—*Joe T. Fallini.*

According to advance notices for the summer field trip at Kamloops, B. C., the tour committee had planned a pace-setting, hustling agenda. The Program committee informs us that the weaker hearts will have to apply for a shot of atomic energy to help them keep up to the activities.

Considerable time was to be spent on the Dominion Range Experimental Station inspecting their facilities and discussing their research program. Trips were planned to the renowned Nicola Valley, one of the top-ranking grazing regions of the continent, and to the Douglas Lake Ranch, the largest in the British Commonwealth.

Members in Washington made plans for a plant identification contest and summer camp for boys, and were busily engaged during the spring in working out the details.

A contest and camp similar to what they so successfully conducted in 1951 are planned by the Oregon members.

The Range Research Committee was reactivated to continue the work carried on last year. Consideration is being given to setting up an exhibit committee to carry on and further develop this medium of educational work of the Section. A very creditable display was prepared for the National Woolgrowers Annual Meeting in Portland in December. Some of that material was also on display at the Annual Meeting of the American Society of Range Management in Boise.

South Dakota

The Northern Great Plains, Wyoming, and South Dakota Sections held a joint summer meeting at the Bob Marshall Camp, near Custer, South Dakota, September 10–11, 1951. Attendance was small and our bills were large, but those who attended agreed it was one of the best meetings they had attended. We even got our bills paid in due time.

The two-day meeting consisted of a half-day indoor and three half-day field trips, each sponsored by a different agency. The Forest Service sponsored the first half-day field trip, with Harney Forest Supervisor Gene Lepley in charge. At the first stop he showed us varying degrees of grazing on bottomlands, hillsides, and ridgetops within easy grazing distance for cattle from Spring Creek. Considerable variation in range condition had taken place. The second stop was an exclosure on Nigger Creek, fenced in 1950 as a cooperative effort of the Forest Service and South Dakota Game, Fish, and Parks Department. Domestic livestock are excluded from the entire exclosure, while only the north half is game proof to exclude deer and elk. It is planned to study effects of protection on willows and other range forage. Our third stop was on Francis Murphy's sheep range, where we studied range condition and "bentoniting" of stockwater ponds to reduce seepage.

On Tuesday morning, the Soil Conservation Service field trip took us to the eastern edge of the Black Hills where range vegetation, utilization, and condition were studied on three ranches. W. C. Krueger, Work Unit Conservationist, Custer County Soil Conservation District, and Les Albee, South Dakota Range Conservationist, had charge of this segment of the program. The mixed prairie association was seen in fair, good, and excellent condition, and the factors contributing to the differences were discussed. We also held a plant identification session.

During a lavish picnic lunch, Superintendent Les Price of Custer State Park presented a brief history of the Park, which contains about 70,000 acres, grazed by approximately 800 buffalo and 1,200 elk. At three stops in the Park, on Tuesday afternoon, Mr. Price and Walter J. Fillmore, Assistant State Forester, discussed range vegetation and condition in relation to production of timber. The range habits of buffalo and elk came in for their share of attention, too.

Evening discussions around the fireplace were supplemented by range and wildlife movies.

The program of the Bob Marshall Camp meeting strictly emphasized management of ranges, rather than reseeding and mechanical treatment.

The South Dakota Section held its third annual meeting in Rapid City on February 16, 1952. The morning session was devoted to the business meeting, including the election of officers. Retiring chairman Les Albee commended South Dakota stockmen for their part in maintaining the State's mixed prairie ranges in good condition. He charged the Section with the responsibility of over-

coming the "short grass plains" misnomer that is all too frequently applied to our range supporting vegetation of the mixed prairie association.

The new officers elected include Carl Ham, Caputa, Chairman; Francis Murphy, Hermosa, Vice-Chairman; and Carl Larsen, Wall, Council Member. Les Albee, Rapid City, automatically became a council member for one year. Chairman Ham appointed Henry Holzman, Rapid City, Secretary-Treasurer. Les Berner, Rapid City, and Sam Wedmore, Hermosa, are the other council members.

The annual meeting program comprised a panel discussion of the timely subject, "Can We Approach Uniform Grazing Fees for Public Lands?" Ike Chase, Chairman of the Black Hills Forest Advisory Committee, served the panel admirably as moderator. Panel members were Bernard Linn, Commissioner of School and Public Lands, Pierre; Bob Morgan, Chief of Range and Forest Management, Bureau of Land Management, Billings; Gene Lepley, Forest Supervisor, Harney National Forest, Custer; Joy J. Deuser, Chief, Land Management Division, Soil Conservation Service, Lincoln; Carl Rawie, Area Range Conservationist, Bureau of Indian Affairs, Aberdeen; and Louis Beckwith, Chairman, Public Lands Committee, South Dakota Stockgrowers' Association, Kadoka.

Nearly half of the sixty-two members and visitors in attendance were ranchers. They joined in a lively discussion of the panel subject.

Plans for our 1952 program will be the topic of our next council meeting.—*Les Albee.*

Issue number 4 of the quarterly newsletter published by this Section was issued in March. Six mimeographed pages were filled with items of business and reports of interest to members. A report of the Annual Meeting at Boise, and of the third annual Section meeting were included, as well as standing committees appointed, and a list of new members. These were interspersed with interesting and pertinent quotations and poems. A Newsletter Committee of three is charged with editing and preparing the newsletter, seven Newsletter Correspondents are charged with providing "bristling, brilliant, newsy, and even scintilating items for the Newsletter."

Southern

A group of Southern Section members and friends got together during the Southern Pasture and Forage Improvement Conference at Baton Rouge, Louisiana, on April 24. They met for dinner over filet mignon and strawberry shortcake, then discussed Section activities and plans for two hours more. Five new Society members were signed up in March and April, and many more prospects are being solicited. A Section newsletter, reporting activities of members during 1951, is being mailed to all Southern Section members.

THE EXECUTIVE SECRETARY REPORTS

Two Society sections, Texas and the Pacific Northwest, are doing some effective work in reinstating delinquent members, as is shown by the fact that several members delinquent two or more years have applied for reinstatement.

Fifty new members were registered during April. It is apparent from this desk that when individual Society members locally put forth efforts to interest new members, that success generally crowns their efforts. For example, Ellis Ruby, formerly a student at Texas A & M, now with the Animal Husbandry Department, University of Arkansas, Fayetteville, comes in with seven; Grant Rogers, Canyon City, Colorado, four ranchers; Bill Allred, four. It should be noted that these members are not on membership committees or other special teams—just feeling their oats a little. A few more members with the missionary spirit like these men and that 1000 new members in 1952 would be a reality.

Among the new members for April were such widely separated applicants as Wayne Dinsmore, President, American Horse Growers Association, Chicago; E. E. McAnelly, Bankers Life Insurance Company, Des Moines; M. Amiz, Hakirjah, Israel; Harry I. Seebert, Lahaina, Hawaii; Jack L. Anderson, Medicine Hat, Alberta, Canada; Gordon L. Burton, Claresholm, British Columbia, Canada.

Thirty six new members were enrolled during May—26 with States addresses, eight Canadian, and two foreign. Three 1950 delinquents were reinstated during the month.

The Executive Secretary plans to attend his first Section meeting June 24–25 with the Pacific Northwest section. The Society load has been too heavy for the Secretary to attend any previous section meetings. If we can get our "housekeeping" duties sufficiently organized, we shall attend some section meetings this fall.

The Director, Pakistan Forest College & Research Institute, Abbottabad, Pakistan has ordered a ten-year membership, beginning with Volume 1, No. 1 of the Journal. He has been supplied the back numbers and placed on the subscription list to receive the Journal for five years.

NOTICE JOURNALS NEEDED

The Society's supply of the following Journals of Range Management is exhausted: Vol. 3, No. 1, Vol. 4, No. 1, and Vol. 5, No. 1. The Executive Secretary's office will pay $1.00 each for these Journals, in order to complete the library and college requests for complete files of the Journal. Mail your copy to: W. T. White, Executive Secretary, 209 S. W. 5th, Portland 4, Oregon. Be sure to print your return name and address plainly on the package