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PROPERTY RIGHTS OF ANIMALS

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PREFACE

The problem here treated includes the property rights and spatial relationships of animals, with special reference to the land vertebrates. With little work done in the way of collecting and compiling materials pertaining to this field, the references and literature were widely scattered. Sources of information included (1) the Zoological Records, the Biological Abstracts, the Encyclopedia Britannica (14th Edition), (2) books in the fields of social psychology, animal biology, animal sociology, animal ecology, bird territory, bird behavior, animal stories, game management, social evolution and populations; (3) magazines, including Auk, Condor, Birdbanding, Ibis, National Geographic, Birdlore, American Naturalist, Science, Science News Letter, Ecology and Journal of Mammalogy; (4) bulletins and pamphlets on observations of the vertebrates. Besides these sources of materials, assistance was received from some personal contacts and from access to unpublished notes. The problem was developed for a master's thesis.

The thesis includes a review of all available literature and a synthetic interpretation of the data concerning property rights of animals with special reference to terrestrial vertebrates as well as a bibliography of about three hundred fifty titles.

For assistance with my work, I wish to express sincere appreciation to Dr. R. V. Chamberlin for suggesting the topic, to Dr. A. M. Woodbury for his untiring cooperation and his invaluable suggestions, and to Dr. Don M. Rees and Mr. Stephen D. Durrant for their helpful criticism, and to all others who aided me in any way whatsoever toward the preparation of this thesis.

PROPERTY RIGHTS OF ANIMALS

A Study of Property Relationships Among Terrestrial Vertebrates

By NETTIE BRADFORD

INTRODUCTION

"Property in its most general sense," says Beaglehole (1932:15), "may be taken to mean the exclusive use, enjoyment and control of those things which are of value in so far as directly or indirectly they serve to satisfy the fundamental needs of the organism. This * * * principle of the use and control of property objects is equally a characteristic of animal, primitive and human societies, and may be judged in all by the same objective standard of defense against aggression." He includes food, mate, young, nest and territory as primitive forms of property, and when, through the drive of fundamental needs, such objects are used, controlled and defended against aggression, he calls them primary property values. He goes further (ibid :314): "* * * with all animals, the dog with his bone, the bird with its nest, the jackdaw with its cache * * * the rodent with its burrow and storehouse and with man himself, the appropriated object becomes a permanent basis of action, something that the individual can count upon and go back to at need. For man, in addition, his property becomes something he can rely upon as a permanent home, permanent means of subsistence and enjoyment, permanent means of exercise of power and winning of social esteem, permanent elements in that integration of personality which alone can yield some measure of order and stability of life."

As the animal kingdom passes in review before us, it shows innumerable evidences of these primitive forms of property, and a variety of ways in which property rights are exhibited. The literature furnishes many references to the forms of property, so many that it is necessary to limit this work to the vertebrates, with special reference to the land forms.

A few of the references to property follow: John Rustgard (1936:208) says: "Even animals will maintain the right to what they find or catch or construct. Birds will defend their rights to their own nests and animals to their holes. The instinct of exclusive right to what one gathers or produces is innate in all living things and does not depend on human statutes." "There are few vertebrates (Francis Pitt, 1927) which do not behave in a purposeful manner." "Each species of animal is a specialist" (Mills, 1923:vii), as it has developed its own way of making a living and its own way of hunting and defending its property. The demands of evolution and the urge of environment have made most species of animals "resident land owners" that exclude others from their special territory. This has given them a better and more reliable food supply and also "added prowess", more leisure time and a real love for home. Mills (1923:54) further says that the homes or homesteads are on the land used, possessed and held by the "homemakers." He thinks that wild animals are not wandering gypsies, but home-loving, contented folk that spend their days and years in a corner of the world which is their own true possession and which they defend if necessary with their lives. The size of land holdings of each animal varies with the species, being largely determined by the needs, the number of population of species in the region and sometimes by certain peculiarities of the animal itself. Often there are disputes over territory. "A mighty mountain lion may seize a section of hunting grounds of the lion across his homestead line. War is

declared, the weaker lion is defeated and is crowded into smaller hunting grounds." (Mills, 1923:57). Wood (1892:1) states that "at some period of their existence many of the higher animals require a home either as a shelter from the weather or a defense against their enemies". Royal Dixon (1918:190) says that "some animals have learned not only to acquire, but also to defend and protect all their property", and he gives an example of animals knowing the exact boundaries of their grazing lands and pastures, and policing their lands against intruders. He has evidence to show that the recognition of boundaries by sheep have been conclusive in determining court decisions. McCabe, in reviewing territory in birds (1932:48), says: "Whenever in the animal world the fundamental requirements of refuge, shelter, concealment or defense arise, a territorial solution almost inevitably follows. * * * It is true that every degree of fixation to locality exists in the world of adult animals from sessile coelenterates to drifting plankton, but it is equally true that something akin to territory is the rule rather than the exception."

Although property is acquired and protected by animals of many species, we find the number of individuals in a locality will often influence greatly their reaction toward their property. Whether a species is common or rare in a given region depends upon many factors, such as (1) "the rate of reproduction which is usually adequate, (2) its adaptability to its habitat" (Howell, 1924:52), (3) the care of the young, and numerous others. Angel Cabrera (1932) goes so far as to formulate a law in which he says "related animal forms are ecologically incompatible and their incompatibility is the more profound the more closely they are related," because related animal forms cannot occupy the same space at the same time. Pearse (1926) says that "competition is most keen among individuals of the same species because they need and strive for almost the same things". Many animals gain mutually by their association with others. We find that the reptiles, birds and mammals gain protection, and often other aid from their association in groups. However, interspecific tolerance decreases with increasing density and may be largely a matter of food competition. Thus we seem to have "an interplay of factors" continually influencing the distribution of the animals, especially birds. Friedman (1931) makes an analogy of bird distribution to a symphony played by a great orchestra in which he says: "We may * * * compare * * * the distribution of birds to a symphony played by a great orchestra. * * * Each instrument * * * is * * * one factor * * * in the environment. * * * At any one moment the individual sounds * * * of the many instruments * * * fuse and blend to form one auditory effect. This is comparable to the range of one species at one time. No two instants are exactly alike in their sound summations, just as the distributions of no two species are ever wholly similar. In the production of certain sounds all instruments may be combined, in others only certain ones, in others two of the component sounds may be mutually interfering and obliterate each other. In other words * * * each present distributional fact represents a polyphony of causes". Chapin (1915:11) goes still further and tells us that "there is struggle between plants and animals of the same species for the same food and space; the struggle against unfavorable climatic conditions, the rivalry for mates and a continued effort to rear young in spite of difficulties. It is due to two factors (1) the limited amount of food and space on the earth and (2) prolific reproduction of living creatures."

PROPERTY RIGHTS

Basis for Property Rights

Although all references do not agree in every detail, still the literature shows that property and property rights have been developed among many lines of animals. Among many vertebrates this development has led to the exercise of rights over such property as eggs, young, mate, nest, territory and food. Of course, the nest or hole, the young, the mate and the food are often things for which the territory is obtained and defended. Spatial relationships are important factors in the life of many animals. Population abundance is closely tied up with these spatial relationships. Every animal comes into the world at some time and in some place through no volition of his own. To survive he must have food, water, shelter or protection, and a space in which to live. More young are produced than can be provided with these essentials, and so there is a continual struggle for existence. Overabundance is sure to cause crowding. This does not seem evident, except at critical periods. For example, when the snow covers most of the food of the quail, then some birds are sure to suffer. Crowding or reduction of space in such birds as some of the warblers may limit the food supply nearest at hand to a danger point, so far as the young are concerned, since the young are very susceptible to temperature changes and cannot survive if the parents leave the nest for extended periods. Certain other birds require a water supply near at hand, a lack of which is critical. Dr. A. M. Woodbury (1938: Field Notes) observed that house finches came to the water holes to drink. The young, as soon as out of the nest, were with the parents. Drying up of these water supplies would mean going farther for water and might be critical. Reports of representatives of the United States Biological Survey who visited the northern duck breeding areas during the drouth showed a marked shortage of breeding ducks and young to the extent that a few dozen small broods of young ducks were seen where, in normal years, millions were produced. A far-reaching inquiry sent out by the Canadian government failed to show any ducks had found a more remote breeding area. (Science, 1931: 166.) The water shortage was evidently a critical factor in the lives of the ducks. Many woodpeckers require dead stumps in which to nest. The common forestry practice of removing dead trees from the forest removes all possible nesting sites for these birds and becomes a critical factor. Statistics show us that few birds die of old age, whereas many die because of other factors working at critical periods in a bird's life. Mrs. Baumgartner (1935) worked this out for tree sparrows at Cornell University. The same undoubtedly holds true of other vertebrate classes. The red tree mouse requires Douglas fir trees to live, both for food and for a home. Naturally, to remove the trees would be critical to the animal. (Benson and Borell, 1931:232). The type of soil seems to be a factor determining the distribution of the kangaroo mouse *Microdipodops*, a sandy loose soil being necessary. (Hall and Linsdale, 1929:300.)

Longley's statement that "populations are likened to gases and solutions, systems of active units acting upon one another at random, differing from one another in secondary attributes but tending, however disturbed, to return to equilibrium," seems to be true, but the populations become greatly disturbed at times, before they ever get back to normal. The Malthusian principle (McAtee, 1936:445) often tends to get started in populations, but is never realized, because increased density lowers the reproduction rate and other factors soon reduce the population.

Certain animals let Nature take its course when crowding occurs. The Dartford warbler (Venables, 1934:59) is almost an example, for it seems to

show little resentment toward over-abundance of birds in a locality. Dixon and Bond (1937) found that despite the concentration of raptorial birds in certain cliff areas "they appeared to exist with surprisingly little friction. A pair of prairie falcons nested slightly over one hundred yards from the duck hawk's nest, but the two species appeared to be on the best of terms. The various pairs of red-tails were never seen to engage in any sort of combat with their neighbors, even the owls." On the other hand, Dr. A. M. Woodbury reports frightening an owl from its nest in the daytime, and seeing two ravens giving it chase. He also reports frightening up two ravens and a rough-legged hawk, who began fighting. First the ravens gave chase to the hawk, but when the hawk got "really mad" he turned on the ravens and made the feathers fly. (Field Notes, 1938.) In many of the vertebrates, however, especially the land forms, over-crowding is retarded and often avoided by the territorial claims exercised by the animals of the given area. Of course, the territories vary as to size, duration and type of protection and use. Sedentary animals are limited to a small area, because of their particular habits.

Greater variation is shown among the mobile animals, especially the birds. The migratory birds have seasonal or cyclical territory. Such birds as the Townsende's solitaire have summer and winter territories, spending the former near timber line and the latter in the low valleys. The red-breasted nuthatch, which ordinarily does not migrate from the high timbers, moves to more favorable territory during very severe winters.

Development of Property

Considering food, mate, eggs, young, nest or home and territory as forms of property, and observing that these forms are closely tied up with each other, we find a number of interesting relationships existing among the vertebrates.

In a discussion of property of animals the evidences of a desire for it and the development of such a desire are often as marked as the exercise of rights to the property. There are many developmental stages in the different animals groups. In certain invertebrate animals, such as the starfish *Luidia,* which deposits about 300,000,000 eggs, and the Atlantic oyster, which deposits about 16,000,000 eggs, we find that fertilization of the eggs takes place at random, with no indication of any desire on the part of the parents to assure the process. In contrast to this behavior, we find that all vertebrate groups show, in some degree at least, a desire for some contact with property. The desires may be periodical or intermittent, or they may be continuous. Just what causes the desires and the variation in them is not really known, although it has been suggested (Report of Rockefeller Foundation, 1936) as due to a "chemical conditioning" of the nervous system mechanism of animals, probably due to hormones. To prove or disprove such a theory opens up a huge field for investigation, which cannot be undertaken here, but the fact remains that such differences do exist.

Property Rights of Fish

Among fish there are numerous steps in the development of property rights and the property urge. Many fish lay a large number of eggs in the open water and the sperms are poured over them, or in the vicinity of the place where the eggs are deposited. (Beebe, 1933:16; Curtis, 1938:164.) Fertilization is more or less accidental and the development of the young depends largely upon chance. This implies that there is developed in the male some sort of attraction to eggs, territory or mate, through which he is drawn to the property, so that fertilization is much more likely to occur than

in those examples in which no attraction exists, such as the aquatic invertebrates, which discharge the sperms at random.

A step higher in development is shown by those fish which build nests. Trout make nests, but do not guard them, although both sexes are present at the nest spot at the time of egg-laying. (Curtis, 1938:190.) The flying fish near Bermuda (Beebe, 1933:16) make a ball-shaped nest by binding a mass of sargassum together. In this nest the eggs are deposited and are left to drift along the surface until they hatch.

Some fish not only construct nests, but also guard them. In the salmon, that leave the ocean and go up the fresh water streams to spawn, we find both male and female making the nest on the stream bottom. The female deposits her eggs in the hollow, and the male sheds milt upon the eggs. (Roule, 1933:66.) As soon as this process is completed the fish lose interest in their surroundings and the eggs are left for Nature to care for them. Kuznetsov (1928:50) found, however, in observing salmon, that the spawner defends

Fig. 1. Common sunfish on nest. These fish construct and guard their nests.

Used by courtesy of W. F. Carbine of the Institute for Fisheries Research and the American Wild Life Institute.

her nest from attacks of other fish from twelve to fifteen days. The common toadfish (Hildebrand, Gilmore and Cochran, 1934:112) of the American side of the North Atlantic lays its comparatively large eggs in mollusk shells, in old shoes, in iron pipes, or any similar container available. The eggs adhere to the surface upon which they are laid and are guarded by the parent fish. The male sunfish construct saucer-shaped nests by scraping away sand from the stream bottom. The female lays eggs in the nest and the male fertilizes them externally. These parents guard their nest and eggs, fanning the eggs and actually removing dead eggs each day. When the eggs hatch, the young are left to shift for themselves. (Beebe, 1933:16; Hildebrand, Gil-

more and Cochran, 1934:108.) Males of bluegill, common sunfish, rock bass and large-mouthed bass (Carbine, 1939:275-287) construct the nest and guard it. The Little Redfish, a landlocked form of the Sockeye salmon, build nests and defend them faithfully. If a strange male approaches, the male darts at him and tries to drive him away. If this fails he may swim alongside and escort the intruder until a satisfactory distance is reached. Spawning occurs when a female settles to the bottom of the nest and a male settles beside her with mouth open upstream so that the force of the current presses his body tightly against the female and the milt and eggs are extruded at the same time. Death usually ensues soon after spawning, so little parental care takes place here. (Schultz, 1935.)

Fig. 2. Portion of a colony of Bluegill Nests located on sand and gravel bottom, with fish occupying six nests. These fish guard their nests.

Used by courtesy of W. F. Carbine of the Institute for Fisheries Research and the American Wild Life Institute.

A peculiar case of nest guarding is shown by the male blunt-nosed minnow, which builds a nest under overhanging rock. He induces several females to lay eggs in his nest. Then he chases the females out and guards the eggs, keeping up a continual fanning motion to keep silt from depositing. The male is very aggressive in driving away other fish until the eggs hatch. He considers this area as his territory, and nothing can encroach upon it.

The male cut-lips minnow *Exoglossum maxillingua LeSueur* (VanDuzen, 1939:65-75), working alone, constructs, cares for and guards the nest. He is active only during daylight hours, but is present at the nest day and night from the time building starts until breeding has ceased. The females are present at the nest only during daylight hours and only while spawning is actually taking place. The young remain in the nest for a period of about six days after hatching.

Betta, the Siamese fighting fish, guards his nest, eggs and young. The male makes a bubble-nest at the surface of the water by releasing bubbles, one after another, each covered with a sticky coating from his mouth, until there is a pile as much as a half an inch high and two inches in diameter. (Chute, 1933:180; Curtis, 1938:165.) He then takes his post directly under the nest and guards against intruders. If a ripe female approaches, the male drives her under the nest. He bends his body into a crescent around her. As they slowly sink through the water she releases several eggs, which are immediately fertilized during the embrace of the male. He then picks up the eggs in his mouth and places them in the bubble-nest. This process is repeated several times. (Innes, 1938:344; Curtis, 1938:166.) The male then drives the female out and becomes a solitary guard under the nest. He repairs the nest when necessary and replaces such eggs as may fall out, until the young hatch. He guards the young for several days after hatching.

The male sticklebacks are famous nest builders. After building the nest, and inducing several females to lay their eggs in the nest, the males fertilize the eggs and then guard them until hatching occurs, and sometimes guard the young for a short time. (Pycraft, 1913:215; Innes, 1938:334.) The male stickleback stoutly defends his territory against intruders. (Alverdes, 1927: 160; Wood, 1892:273; Duncan, 1926:58; Uexkill and Krisgat, 1934; Shoosmith, 1937:195.) "These animals display a strange instinct of appropriating to themselves a certain part of the tank in which they may be confined and furiously attacking any other stickleback which may presume to cross the imaginary frontier." (Romanes, 1912:246.)

Still another fish guard not only their nest and eggs, but also their young. The male bowfin guards the nest and eggs, and after the young hatch, he guards them as they swim about in schools. (Metcalf, 1932:217; Hildebrand, Gilmore and Cochran, 1934:109.) Black bass (Goode, 1903:59; Chute, 1933: 88) guard their "newly-hatched fry" and drive away predators and intruders of all kinds.

There are fish that care for their young in pouches. In the pipefish, the eggs are laid on the ocean bottom. The male then fertilize the eggs which are placed in special brood pouches on the ventral side of his tail. The eggs are retained until they hatch and the young remain for a while in the pouch. They even return to the pouch in time of danger, but only for a short time, since they soon begin to shift for themselves. (Beebe, 1933; Hildebrand, Gilmore and Cochran, 1934:110; Chute, 1933:75.) The male seahorse (Beebe, 1933:78; Hildebrand, Gilmore and Cochran, 1934:111), "among the weeds of the shallows near Bermuda, collects the eggs of his mate into a fleshy pouch on the front of his body like a diminutive kangaroo and guards them until they hatch."

The marine catfishes exhibit parental care by incubating the eggs in the mouth of the male, and sometimes by carrying the young for some time after hatching. (Hildebrand, Gilmore and Cochran, 1934:113; Pycraft, 1913: 219.) The female Egyptian mouthbreeder, *Haplochronus multicolor*, allows her young to leave her mouth at first for short periods. At the least sign of danger they all rush back to her mouth. This care ends only when the babies get too big to crowd into their refuge. (Innes, 1938:380.)

While a large majority of fishes lay eggs and are called oviparous, several species produce live young. In such fish internal fertilization takes place, and the young are retained in the body of the mother. (Pycraft, 1913:214; Hildebrand, Gilmore and Cochran, 1934:103.) In certain minnows the young are retained until they are fully developed. Such fish as the sharks and rays also give birth to living young. None of these fish, exclusive of a few sharks,

have any semblance of a placenta, and the embryo receives no nourishment from the blood of the mother, therefore most of them are ovoviviparous, whereas the few sharks may be considered to be viviparous. (Hildebrand, Gilmore and Cochran, 1934:104; Curtis, 1938:169.)

Most fish do not hold and defend territory. However, certain fish periodically defend the nest or nest territory along with the eggs and sometimes the young. The male bowfin, black bass and stickleback are all very aggressive in this defense of territory. With bass fry (Langlois, 1937:459) some larger individuals claim particular individual niches around the pond margin where they wait and capture smaller fish that pass by. These territories are temporary, for as soon as the food supply is used up by these individuals that have assumed proprietorship of particular areas in the pond, these fish have to turn to dependence upon an external food supply and leave their claims, often joining the schools of bass that are already formed. In some of the nest-building cichlids the male seems to stake out a claim on a piece of territory. From this area he drives out all other fish until a ripe female comes. Then a courtship ensues, and may last several days, and both fish guard the territory. They select a hard surface, which they clean thoroughly, and the female moves slowly over the surface, depositing a row of eggs over which the male immediately deposits milt. This is repeated a number of times. Then the parents guard the eggs until they hatch. After hatching, they watch over the young, driving away enemies. (Curtis, 1938:168.) "No hen could be more solicitous for her flock than are these devoted fish-parents for their fry." (Innes, 1938:371.) The Demoiselle fish "live throughout the year in pairs, selecting a hollow or a little cove or crevice among the coral, and spend all their time in or near it, defending it against all intruders, large or small." (Beebe, 1933:187.)

Observations have been made that tend to indicate that schools of fish, such as some of the silversides, *Atherinidae,* show social territory. A school of silversides sometimes collect in shallow, grassy areas for the purpose of depositing their eggs. A great churning of the water takes place and millions of eggs laid quickly become attached to the plants by threads which branch from the ova at one point only, thus preventing the eggs from falling into the mud. (Hildebrand, Gilmore and Cochran, 1934:115.) Schools of bass fry (Langlois, 1936:177; 1937:459) occupy given areas to aid in obtaining food, and it seems, in order to withstand adverse conditions of temperature, etc., better than alone.

Thus it would seem that fish show not only primitive property rights, but also some that are well developed. These are indicated by such attractions as the following:

1. Insurance of fertilization:
   a. Most male fish to eggs or mates periodically, and
   b. Living together, in pairs, permanently (one case).
2. Care of eggs:
   a. No defense of eggs (many cases);
   b. External defense of eggs (many cases);
   c. Carrying eggs in brood pouches or in the mouth of the parent (several cases);
   d. Internal care of eggs—ovoviviparous and viviparous (several cases).

3. Care of young:
   a. No defense of young (many cases);
   b. External defense of young (few cases);
   c. Carrying young in brood pouches after young hatch or in mouth of adult (several cases).
4. Territory:
   a. No defense of territory by many fish;
   b. Periodic defense of nest and nest territory (several cases);
   c. Permanent defense of pair territory (one case);
   d. Occupation of social territory by a school.

Property Rights of Amphibia

Most aquatic salamanders lay their eggs in water. The male four-toed salamander *Hemidactylium scutatum* secretes spermatophores and leaves them in water. (Blanchard, 1933:40; Branin, 1935:174.) The female is attracted to the spermatophores and draws them into her cloaca, and the eggs are fertilized internally. It is probable that other salamanders have similar habits. Some terrestrial salamanders return to water to lay their eggs, while others lay their eggs beneath logs or stones and the female guards them. (Noble and Mason, 1933.)

Fig. 3. A pair of Desert Toads in pools of stream bed. They have mutual attraction to each other during the egg-laying period, but abandon eggs and mate thereafter. Photo by Joseph Dixon.

Most frogs and toads lay their eggs in water. The male clasps the female during egg laying and fertilization takes place while the eggs are being laid. The parents, in most cases, then abandon the eggs. The tadpoles live in water, feeding and developing with no parental care. (Hegner, 1929:453.)

On Stephen Island, off the coast of New Zealand, has been found (Blanchard, 1935:656) a frog whose eggs are laid in the ground. The tadpoles develop enclosed in the jelly-like egg capsules. The frogs hatch from the eggs in about a month, when both pairs of legs have developed. There is thus no free larval stage; the tadpole does its swimming within the egg membrane and metamorphosis begins before hatching.

Some amphibia show remarkable ways for caring for their eggs and young. (Walter, 1928:37.)

1. Indirect protection of egg is provided by means of nests or nurseries, and the young are left to shift for themselves.
   a. *Hyla faber,* a Brazilian tree frog, building enclosures of mud in the water, into which it lays it eggs and leaves them. The developing tadpoles escape many enemies that are present in the larger pool. (Pycraft, 1913:192; Metcalf, 1932:219.)
   b. *Hyla resinifictrix,* a tree frog, lays its eggs in resin-lined rainwater holes in trees.
   c. *Rhacophorus schlegeli,* a Japanese tree frog (Pycraft, 1913:192) forms a chamber a few inches above the water level in the damp earth on the edge of a ditch or flooded rice field. Here the female works up a froth from the secretion from her mouth and, with the male clinging to her, she lays her eggs, which are fertilized by the male. The pair then separate and the eggs are left to hatch without any concern of the parents.
   d. *Phyllomedusa hypochondrialis* glues its eggs to folded leaves overhanging the water.
   e. *Rhacophorus reinwardtii* deposits its eggs in jelly-enveloped, overhanging twigs. (Walter, 1928:37.)
2. Direct care of eggs by parent coiling around them is found among:
   a. *Ichthyophis glutinosa* of Japan, in holes in damp earth;
   b. *Plethodon,* in the United States, doing the same thing under logs and stones.
3. Direct care of eggs by parents who carry their eggs around with them in such ways as:
   a. Around the neck by *Desmognathus fusca;*
   b. Around the hind legs of the male by *Alytes obstetricans,* European midwife toad;
   c. Glued to the back of the female of *Hyla goeldii,* a South American tree frog;
   d. Glued to the belly of the female *Rhacophorus reticulatus;*
   e. In the dorsal pouch of female *Nototrema pygmoeum* of Venezuela;
   f. In the mouth cavity of female *Hylambates brevirostris;*

g. Within the vocal sacs of the male *Rhinoderma darwinii* of Java. The male of this amphibian (Pycraft, 1913:197) has a pouch under his throat which serves as a voice organ during courtship and as a container for eggs which hatch and develop through the tadpole stage, leaving the pouch as young frogs;

h. The skin on the back of the female Surinam toad swells up around each egg like a pit, and the young emerge as fully developed toads in miniature. (Pycraft, 1913:192-197; Walter, 1928: 37.)

4. Internal care of eggs:

   a. Eggs of *Salamandra atra* of Switzerland are kept within the oviduct until after metamorphosis-ovoviviparous. (Walter, 1928:37.)

5. Direct care of young:

   a. In pits on back of Surinam toad;

   b. Instances are given of tadpoles being transported to fresh water pools by attaching to the male *Arthroleptis seyschellensis* and by attaching to the female *Hylodes lineatus*.

The amphibians show some advances over the fish in their development of property rights. They show some changes in their life history due to their amphibious life, the terrestrial life having been added to that of the fish. They also show practically all inter-graduations from long tadpole life in water to the condition of passing the tadpole stage in the egg and hatching as fully metamorphosed frogs.

It would seem that amphibians show primitive property rights periodically. These are manifested through a series of attractions, as follows:

1. Insurance of fertilization:

   a. Female salamanders to spermatophores.

   b. One sex to the other in most toads and frogs.

2. Care of eggs:

   a. Indirect protection by providing enclosures of mud, resin-lined water holes in trees, frothy foam, or gelatin covering.

   b. Direct care of eggs by parent coiling around them.

   c. Direct care of eggs by parent carrying eggs around the neck, around hind legs of male, glued to back or belly of female, in a dorsal pouch and in dorsal pits of female, in a mouth cavity of female and in vocal sacs of male.

   d. Internal care of eggs (ovoviviparous).

3. Family care:

   a. No care—most amphibians, with few exceptions.

   b. Tending tadpoles in pits on back.

   c. Tending tadpoles that attach themselves to male in one case and female in another case.

Property Rights of Reptiles

Reptiles show definite sexual attraction. This is correlated with internal fertilization which is effected in the oviduct after the eggs leave the ovary and before the egg-membrane or shell is completed. In contrast with the eggs of fish and amphibians, reptile eggs have large mass storage of food and water which enable the growing embryos to pass through the aguatic phase of development so that they are transformed terrestrial animals by the time they hatch. In other words, they pass the tadpole stage in the egg. This, in itself, is a great forward step in the care of eggs over the fish and amphibians.

There are several further stages in development shown by reptiles:

1. A large number of them *bury their eggs* in the ground or in trash, where they are left to incubate by the heat of the sun or by that generated by decaying vegetation. The young take care of themselves as soon as they hatch.

2. A few lizards (mainly the skinks) and some snakes (e.g., the python snakes) *guard and protect their eggs* until they hatch. (Noble and Mason, 1933; Shoosmith, 1937:194.) The female lizard *Eumeces* remains with the eggs until they are hatched, and some species, vigorously protect their eggs against mice, lizards and snakes. (Noble and Mason, 1933.) "Among sea snakes, in a group of viviparous snakes, *Laticauda columbrina,* which lay eggs, the female guards the eggs and snaps at intruders. Hence, the brooding habit characteristic of the cobras but lost in most sea snakes reappears" (ibid). One common water snake in Europe guarded her clutch diligently for thirteen days (Pope, 1937:70-72). A pit viper defended her six eggs valiantly and remained with them for several days. In most cases only the female attends the eggs, but the male may also take part. The male king cobra is said to remain near while the female enfolds the eggs. An example is given of a pair of cobras in the Belle Vue Zoological Gardens diligently tending their eggs from March 8 to May 12, the male always remaining near the nest and taking the place of the female when she left to feed and drink. Both the parents were unusually vicious while in possession of the eggs (Pope, 1937:72).

3. Female crocodiles watch over their eggs, help the young to emerge, and lead them to water (Alverdes, 1927:68); Pycraft, 1913:157). The female alligator protects its young even after this point (Alverdes, 1927:68). E. A. McIlhenny, who has spent his entire life on the family estate in Louisiana and has studied alligators since boyhood (1935:441) states that the young remain with their mother until the onset of the breeding season the spring following their birth; and he has on several occasions seen the mother crush an animal in her jaws and hold it at the surface of the water for her young to devour.

4. Such reptiles as the garter snake, rattlesnake and horned toad retain the eggs in the oviduct until they hatch and give birth to living young (Metcalf, 1932: 220). Although there is no parental care of the young shown in the majority of reptiles, still we find more and better care of the eggs. The slowing down of the passage of the eggs through the oviduct gives a better chance for development

and care of the embryos than external development does. Despite the story of snakes swallowing their young for protection, Dr. Woodbury reports seeing young and parents lie around in the same spot in the presence of danger with no evident attraction to each other. It may be that social attraction has developed from this grouping, but to date there is no evidence of protective interest of one snake toward another.

Fig. 4. A wandering garter snake and young in captivity. The young hatched immediately after the eggs were laid. Neither mother nor young exhibited any attraction to each other even though kept together for weeks. Photo by Dr. A. M. Woodbury.

We find, among reptiles, examples of early stages in the development of property, although the mate seems necessary only for the reproductive act, the eggs and nest, if such exists, have a very elementary attachment, if any, and the young are mainly ignored. With lizards it has been found that the male recognizes the sex of another lizard by the reaction that occurs. If the other lizard offers resistance, he recognizes it as a male; if it does not offer resistance, it is recognized as a female. The female lizard *Eumeces* has been found to guard and protect her eggs against mice, snakes and lizards (Noble and Mason, 1933). The male fence lizard takes over a feeding space for himself. This may be a fence rail or a single ledge of rock where he remains and resents, often viciously, the intrusion of another lizard, or even another animal. The female has a given area where she lays her eggs. She often protects them against imposters, but as soon as they hatch she loses her urge to protect them. The female then takes over her solitary feeding territory, on which she resents any competitors.

Defense of territory has been observed:

1. Evans (1936:53-55) found that "in males the urge to acquire and hold a certain restricted territory is very marked. The resident male wins in ninety-one percent of the combats, because he fights harder to defend territory than the non-resident does to acquire". "Combativeness and the urge to defend territory are shown to be stronger in castrated females than in normal females". (Ibid.)
2. D. D. Davis (1936:257-290) says: "One of the most striking features of behavior of lizards is the assuming and defending of territories by the males."

3. Schmidt (1935:72) states: "Old males of *Amblyrhynchus cristatus* in the Galapagos Islands fight for territory."
4. Ditmars (1936:23) says: "Vicious, indeed, are the fights between rival males of the American chameleon, *Anolis carolinensis,* for an exceptionally desirable stretch of fence rail."
5. Woodbury (Field Notes, 1937) states: "The lizard *Sceloporus magister* establishes a food territory for himself which is near easy shelter. When established, he tends to claim it and fights against others of the same species for his property rights."

Fig. 5. Desert Tortoises tend to congregate in long tunnel-like dens shown above in winter but spread out as solitary individuals or pairs in summer. Photo by Dr. A. M. Woodbury.

Such observations as the above would tend to establish the fact that defense of territory is truly a characteristic of lizards.

Dr. Woodbury's observations (Field Notes, 1937) of the desert tortoise show that they spread out in a territorial arrangement in summer, but den up in winter.

We have examples of group territories among the snakes. They seem to occur as a (1) means of mutual protection against weather extremes or (2) perhaps from social interest. The congregating of snakes in large numbers is of great advantage in regions where suitable places for dens are scarce and snakes are numerous (Pope, 1937:113; E. R. Hall, 1929). Medden (1930: 109) tells of rattlesnakes living in holes of prairie dogs. He quotes Bradford's journal of 1775: "The rattlesnake is solitary and associates with her kind only when it is necessary for her preservation. In winter the warmth of a number together will preserve their lives, while singly they would prob-

ably perish." It would seem that the congregating of rattelsnakes in dens is a means of protection against winter cold; but, as suggested by Woodbury and Sugden (Mss. 1936), the den seems to serve as a headquarters for social contacts. Sometimes snakes' dens are inter-specific, for along with the rattlers, gopher snakes and striped racers have been found. The fact that snakes return to the same dens year after year fits into Beaglehole's statement that the territory or property is a place to return to at need (1932:314).

The reptiles show some advances over the amphibians in their development of property rights. These advances include (a) spread of sexual attraction to all adult members, (b) mass storage of food and metamorphosis of embryo in the egg, (c) protection of eggs by burial, (d) beginnings of feeding of young by alligators, but as yet there appears to be no evidence of external storage of food.

The property rights are indicated by the following attractions:

1. Insurance of fertilization: attractions of one sex to another in all adult members of a population, correlated with internal fertilization.
2. Care of eggs:
   a. By burial in ground or decaying vegetation (most reptiles);
   b. External defense of eggs by male, female or both (in a few cases);
   c. Internal care of eggs in oviduct (ovoviviparous).
3. Care of young:
   The vast majority show no care of young, but
   a. Crocodiles show beginnings of parental solicitude, and
   b. Alligators show beginnings of actual feeding of young.
4. Territory:
   a. Some lizards show solitary feeding territories, and
   b. Some snakes and tortoises show winter den group territories.

Property Rights of Birds

Family Relations—

Birds show definite sexual attraction and internal fertilization on much the same principle as the reptiles, except that they have perfected the method of development of eggs by more efficient and better organized storage of food and better shells, and have introduced a courtship procedure which in many cases amounts to a ritual.

The stages in development vary a great deal:

1. The mound builders and brush turkeys of the East Indies, like certain reptiles, lay their eggs in mounds of vegetation and depend upon the heat of the sun or decaying vegetation for incubation. (Thomson, 1923:296.) The parents have no attraction to the eggs, nor do they show parental care for the young.
2. The scratching birds, such as the quail, chicken and other scratchers, lay their eggs in nests, and incubate the eggs by sitting on them. The young are precocial and can run about soon after hatching. The parents guide, guard and protect the young, and often show them where food can be obtained, but do not feed them.

3. Altricial birds, as a rule, also build nests in which the eggs are laid and incubated. Often one parent does as much toward building and incubating as does the other. The young, after hatching, remain in the nest for a considerable period of time. They are fed and tended by the parents while they remain. In some birds the care of the young ceases as soon as the young leave the nest. However, many birds tend their young after they leave the nest. With the red-winged blackbirds, Linford (1936:6) outlines the time of family duties:

Nest preparation	3 to 5 days
Egg laying	3 to 5 days
Incubation	11 days
Rearing of young in nest	10 to 11 days
Training of young outside nest	12 to 16 days

I have seen parent robins feeding young which were fully as large as the adult birds. Chipping sparrows tend the young in the nest for nine days (Dr. Woodbury, Mss. 1937) and outside the nest for as long as six weeks. The gannets (Murphy, 1938:246) of the North Atlantic, which breed in the Gulf of St. Lawrence, show that six weeks are spent in the egg, about three months in the nest, where they are well cared for by the parents, and several years in reaching maturity.

Many families are parent families, that is, both parents care for the young and remain with them, although they may exist as such through only a short period of the year. The prothonotary warbler (Walkingshaw, 1938) family is a true parent family, for both birds build the nest, and although the female incubates the young in the nest, the male feeds them almost entirely. Both birds feed the young for at least a week after they leave the nest. The short-billed marsh wren (Walkinshaw, 1935) incubates its eggs for twelve to fourteen days, and after hatching, the young remain in the nest for thirteen days, where they are fed by both parents. Bushtits (Addicott, 1938) form parent families, both birds sharing in building the nest, incubating the eggs, and brooding and feeding the young during the early stages of development. Chipping sparrows are also parent families, with both parents feeding the young. Latimer's vireo shows both parents assisting in all activities. (Spaulding, 1937:17-28.)

There are birds in which but one parent in the family cares for the young. Hummingbirds (Prather, 1929) might be called mother families, since the mother takes complete care of the young, the father congregating with other males at a common feeding ground. Among polgynous birds, such as the chicken, mother families are the rule.

The phalarope (Thomson, 1923:291) might be called a father family because the male bird cares for the young, the female leaving it entirely to him. Another father family is that of the spotted sandpiper (Nelson, 1930), in which the male incubates the eggs, broods and cares for the chicks.

Most birds have an annual breeding cycle, building their nests and laying their eggs early in the spring. A few birds, for example the goldfinch, do not lay their eggs until late in the summer, while the birds of prey generally lay their eggs late in winter or very early in the spring (Metcalf, 1932:221). Some other birds build more than one single nest in a season, the robin and the bluebird often nesting two or sometimes three times, while the English sparrow breeds practically continuously from early spring to late fall. Mrs. Laskey (1935:375) says that a mockingbird may have five sets of eggs in a season. The eggs hatch in twelve days, and the young leave the nest on the eleventh day.

The above facts indicate that mate, nest, eggs and young are essentials in the lives of birds. They are all property values that birds defend and protect, exercising rights over them in many cases. Along with these factors we find food and territory to be very important.

Territorial Relations

Interpretations of territory have been given by a number of bird students. Howard (1929:64) says: "The theory of the function of territory is that it spaces the pairs to insure adequate supply of food for the young. This is effected in the following manner: The male isolates himself, makes himself conspicuous, becomes intolerant of other males and confines his movements to a definite area." Although Howard (1920) should be given the credit for making us realize that territory is an important factor in bird life, still "the facts are not new" (McCabe, 1932:42). Some of the main points of Howard's hypothesis were suggested by Naumann in 1820, while all of the basic facts were stated by Altum in 1868 and 1898 (ibid). Dr. Mayr (1935) tells us that Altum was the true father of the territory theory, that he believed firmly in the food value of territory for the young and in the use of song, both to attract the female and to repel other males, but that he pointed out the fact that many species do not hold territory, and that he said that "the males fight to fix the size of the territory". Dr. Mayr, himself, holds that we have no real definition of territory, and he proposes a formulation of one, as follows: "Territory is an area occupied by one male of a species which it defends against intrusions of other males of the same species, and in which it makes itself conspicuous." This definition, however, does not include winter territories nor female territories, nor the purpose of territory, but it does include territories of certain social birds.

Allee (1932) says of territory that the evidence shows that the males take up rather definite areas before the breeding season starts and "maintain their position during the breeding season, driving off intruding males before and after the female has appeared to accept the territory and the male as her mate. Such spaced community organizations are apparently widespread among birds and again indicate clearly a distinct social development. These territorial relations are not limited to birds, but also are shown for fishes as well as for mammals."

Mrs. Nice (1933) outlined the theory of territorialism and its development. She holds that "territory implies in the male bird isolation, advertisement, fixation and intolerance," and "where these four aspects are not present the bird does not truly hold territory." She goes further by saying that "the very essence of territory is in its exclusiveness, and if it is not defended it is not territory."

Dr. Tinbergen (1935 and 1936) holds that territory is of rather minor importance in the life of birds. He thinks that fighting is a sexual function and has nothing directly to do with protection of boundaries or property. Mrs. Nice (1934b), however, believes that "the purpose of territory is primarily to prevent interference in family life. It probably arose from sex jealousy, but it has come to mean something very definite in the male: a piece of land of certain size and special ceremonies in procuring and defending it".

It would seem that "territory was originally developed only in connection with mating, but it has acquired in certain passerine species a secondary significance as the food-providing area." (Mayr, 1935.) F. H. Allen (1935:100) remarks: "Like McCabe, Mrs. Nice is not disposed to go all the way with Howard. She denies territory to those birds that defend a nest spot but feed in common, and to such birds as the cowbird, which pass the

breeding season in more or less definite areas without attempting to defend them. * * * Mrs. Nice calls attention to the possibility that the food aspect of territory has been over-emphasized and the sex jealousy may in many cases play a definite part. But may it not *always* be a matter of sex jealousy *and* food?" Perhaps the term "home range" might be used in such cases.

The Lacks (1933) contend that there is not enough evidence to show that territory is a general law of bird life and there is no proof that territory is of food value or is an important factor in the prevention of over-crowding. "In fact, territory seems to be nothing more than an affair of the male bird, and its real significance seems to be that it provides him with a more or less prominent isolated headquarters where he can sing and otherwise display." The Lacks say that the earlier fighting, i.e., territory fighting, apparently ceases in almost all cases when the eggs have been laid. Selous (1933) seems to agree with them when he says that doubts are expressed concerning the territory theory, since "the actions which seem to be protecing a territory are really due to jealousy over the mate". Most territory students, however, do not agree with the Lacks. Mrs. Nice (1934) found with her two to four brood song sparrows that territory lines are maintained till the nesting is over and that territory distinctly limits the pairs in her locality, and also safeguards the food supply. In describing the territorial behavior of coots and mute swans, Julian Huxley (1934) says: "In their paper, the Lacks state that there is no real evidence that the pugnacity of the male sets a definite limit to the number of pairs in a givern area. In these swans it would certainly appear that it was doing so. The pugnacity of the male is clearly seeing to it that one pair of swans shall grow where two pairs grew before."

C. B. Moffat (1903;1934) says that the chief use of territory is to prevent undue increase of any species by preventing the less vigorous individuals from breeding. He claims that fighting is for territory and not for mates. It is clear "that the battles of male birds each claiming a territory resulted in such a parcelling out of the land as must limit the number of breeding pairs to a fairly constant figure and prevent indefinite increase in case of any species." This would seem to agree with A. Brazier Howell (1924) when he states that among the causes governing the distribution and abundance of any form of vertebrate, "food supply is usually listed as of first importance, second in rank being accorded to the presence or absence of suitable breeding sites and third to proper cover."

D. Nethersole Thompson (1934:14-23) believes that territory is not an end in itself, but a means to success in reproduction. If such success is more likely to be attained by exclusiveness, the tendency is for territorial boundaries to be maintained, but if food becomes abundant and enemies disappear, then the boundaries seem to disappear until circumstances urge their readoption. Dr. Palmgren (1932a:23), in his observations on territory in Finland, agrees with the Lacks, that we have theorized on territory more than we should, but he believes that territory is something more than a song-center of the male.

Howard (1935) says: "To sum up, the territory is useful in various ways, but not necessarily in the same way for every species. * * * The main determining factors of territory are (1) supply of necessary accommodation for rearing offspring and (2) adequate supply of food in close proximity to the nest." Hamer (1922:57) states that "the purposes fulfilled by territorialism are (1) conservation of a food supply and (2) jealous reservation of female partners or partner."

According to Tinbergen (1936), defense of territory is not the only function of fighting, but often the fighting is to secure a mate. Why can-

not we make our term broader and speak of defense of property where the nest, the mate, the territory, are all forms of *property* which the bird protects and defends? Tinbergen also says the Lacks speak of colonial birds as opposed to territorial birds, but from his own observations, a colonial bird may be just as territorial as a solitary bird. With the herring gull, every pair has a strictly defined territory which is defended against other herring gulls. In terns, the case is nearly identical. Huxley's motion picture of gannets shows incubating birds picking at trespassers. In general, sexual fighting in all animals serves to secure the objects necessary for reproduction, namely, territory and a mate. (Tinbergen, 1936.) "The bird will defend from attack and violence its mate, its food, its nest, its young and at certain seasons its territory." (Beaglehole, 1932:93.) These objects of defense are essential to the well-being of the bird, therefore they are property to which it demands its rights.

Territory as property shows many types of development. Most birds at some time or other hold territory, although for a very short period in some cases, and permanently in others. The average male bird takes up a territory which he defends for a few days before he obtains a mate. Here we have a *temporary, solitary* territory, which soon becomes a *temporary pair* territory, at least through the nesting and incubating period; then it becomes *a family nesting* territory for a short period, after which boundaries are little noticed by the birds in question.

The European cuckoo might almost be considered a permanently solitary bird, for the birds live in a state of promiscuity, and they care little, if any, for the eggs after they are deposited in the foster nest. (Finn, 1931:187.) Certain other birds are solitary throughout the year, except at the breeding season. Their property consists of territory and food throughout most of the year, but includes nest, mate, eggs and young at the breeding period. The Townsend Solitaire is such a bird. The Argus, a pheasant, is most unsociable. He keeps his dancing ground in order (Beebe, 1926:173-217), but seldom sees another Argus, excepting at the breeding season. The male Lyre bird (Jennison, 1928:217; Ambrose, 1937) has his own little mound, which he guards against intruders. The shrike is another bird that prefers its own company, except for the breeding season (Miller, 1931:11-242). It vigorously resents other shrikes on its territory within which he hunts and feeds independently throughout the year. During the breeding season a given individual shrike territory becomes a pair territory in which the female selects the site and builds the nest. The male does not assist in incubation, but he does bring food to the female. The male stays close to protect against danger or intrusion. Later, when the young hatch, the territory becomes a family territory with nest, mate, young and food, all there until the time when the family breaks up and each individual finds a new territory, leaving the original site to one of the adults, usually the male.

Other birds have a *permanent pair* territory throughout the year. With the Nuttall white-crowned sparrows (Blanchard, 1936:145-150) the male patrols his boundaries, chasing off neighboring sparrows. The territory becomes a combination of family feeding and nesting territory during the latter part of the breeding season, that is, until the young birds shift for themselves and go off to take up their own territories. Male ovenbirds in southern Michigan (Hann, 1937:145-327) arrive nine to fourteen days before the females. They take up their individual territories and defend them immediately, and the choice is usually permanent in each case. The size of the territory varies with the desirability, but usually includes material for nest and also required food. When the boundaries are once fixed they are rec-

ognized by other ovenbirds. This territory becomes a pair territory and then a family territory. It has been found that adult birds return to their old sites. An instrument, called an itograph, was used to record the movements every time the parent birds entered or left the nest. It was found that time off the nest increased as the birds grew larger and required more food. The ovenbirds are good protectors of the nest and its contents. While employed in nest building (Wood, 1892:312) they are very jealous of the presence of other birds and drive them away fiercely. With *Sitta carolinensis*, nuthatch, Butts (1927:327) found that the birds go about in pairs throughout the winter, with a definite feeding territory which they actively defend. They nest within their winter feeding territory.

Temporary pair territories are observed in many birds, such as the mourning dove. Both birds search for a nesting site and when it is decided upon, the female stays there and builds the nest under and about her from the material brought by the male, who stands guard to keep the female on the nest. (Gander, 1928:98.) Close observation leads us to believe that hummingbirds live during the breeding season by the law of "claim staking" (Prather, 1929). Other hummingbirds are resented and driven away. When a location is found sufficiently large to provide for needs of a growing family, "it is staked out in the name of the female, who holds undisputed possession of her domain". The male bird will drive away any big creature that he suspects of being an enemy to himself or his family. (Arnold, 1935; Orr, 1939:17-24.) There is no doubt that a hummingbird having laid claim to a particular feeding ground resents any competition within its limits. (Woods, R. S., 1927:305.) These vested rights seem to be recognized by intruders who seldom tarry to dispute possession. The territorial boundaries of the Bishop bird are rigid and seem to be maintained through the season. The male finds his food inside, never leaving except to find water. He parades the boundaries and never tolerates strangers of the species. The female does not defend the territory, but incubates and feeds the young alone. She does not even seem to have a sense of boundaries and often is attacked by neighboring males when she is in search of food outside the territory of her male. (D. Lack, 1935.) The value of territory in this bird seems to be for the isolation of the male and to assist the female to get a mate, for it is common for a male to have up to four females in different stages of nesting in his territory at once. Here vigorous territorial behavior is obviously divorced from food supply.

Family territories are found among many birds. With precocial birds, as the quail, chicken or other such scratching birds, where the young leave the nest shortly after hatching (Williams, 1937:461), the territory becomes primarily a family feeding territory. Other birds, such as the tufted titmice (Gillespie, 1930:120), remain together in family groups in winter and occupy very definite and limited areas. Still other birds form groups of families for at least part of the year. The red-winged blackbird (Linford, 1936:11; A. A. Allen, 1934:83) shows the male to have a solitary territory for a few days, until he secures a mate, after which time there is a pair territory until the young hatch. Then there is a family territory. The territory is more important in guaranteeing adequate food supply for the young than in furnishing a nesting site. Both male and female act in defense, but the male is more active to defend the territory, and the female the nest and young. The family groups remain together for two or three weeks after the young have left the nest. They then begin to gather more and more into larger, unstable flocks of both sexes and all ages as time goes on, especially while feeding. In Michigan the pheasants retain the brood unit up to the time of fall dis-

persal. By the hunting season broods have broken up into small, loose groups of mixed sex and age. (Wright, 1931.)

Group feeding areas are common with birds. Rosy finches feed together in flocks. (Hansen, 1938.) Males of the Alaska Willow Ptarmigans gather in compact flocks for feeding and mutual protection from foxes and other natural enemies. (Jos. Dixon, 1927:223.) The male hummingbird, during the rearing season, "goes to the club" or male feeding ground. (Prather, 1929; Orr, 1939:17-24.) Aggregations of families are the rule in fall and winter in such birds as the quail. (Leopold, 1933: Ch. IV.) Banding proves that late summer and in fall quail coveys may be composed of one to three pairs of adults and their surviving young, with the addition of frequently one to several unmated cocks or pairs that have failed to bring off broods * * * and often young that have become lost from their own covey or scattered by hunters (Stoddard, 1931). Every member of a covey may wander away during the nesting season. At best, only a few birds of any covey occupy the same range from year to year. Errington (1933) found that coveys in Wisconsin showed "essential stability" in location and membership during the winter season. In Gambel quail the tendency is for winter coveys to combine temporarily, but split up again before nesting begins. (Leopold, 1933.) Gorsuch says of quail in southern Arizona that the appearance of winter annuals (plants) in December is the signal for consolidation of coveys into communal bands in which mating takes place. When these bands disperse the cocks and hens go to either his or her covey range. (Leopold, 1933.) Arnold (1935) says, "The bobwhite family will stick together throughout the year until nesting or mating time." Wild turkeys form in flocks, probably family units, in the early fall. Gobblers form packs from nesting time until the young are two-thirds grown. The ruffed grouse has a tendency to form in large packs in winter. Prairie chickens probably remain in broods or combinations of broods up to November, but then tend to form large aggregations called packs (ibid). Presnall (1935:199) tells of the huge flocks of juncos and the flocks of Gambel sparrows which spend the winter in Zion Canyon, using the area for protection and feeding. Among flamingoes there are often sentinels which stand watch while the flock eats. (Jennison, 1918:110.) The white-cheeked geese in California roost in large groups in a pond and send out an advance guard before they leave in several flocks for the feeding grounds. (Moffitt, 1937.) The Twelve Apostles birds of Australia build nests close together for mutual protection, one hen keeping guard over the nests. When the young hatch, a group of adults feed them. The nest is respected as common property of the bird group and each is interested in its welfare. (Dixon, 1918:140.)

Group sleeping quarters as observed with swifts (Rourke, 1936:51) and other birds (Allee, 1932: Ch. XII; Allee, 1938:47) indicate the mutual benefits of group protection. Constance Rourke (1936:51) tells of Audubon's observation of "an immense cloud of chimney swifts" which at evening descended upon a tall sycamore outside the town, entering the tree through knotholes. With the aid of a lantern he was able to see the birds lining the hollow trunk so close together that a finger could not have been placed between them. All was silence until early daybreak, when from within came a sound as if the tree were splitting and the swifts began to emerge, making their way in a dark stream to the chimneys of Louisville. Alexander Wetmore (1932: 460) tells us that in July and August each year, after the nesting season is over and the young are on the wing, flocks of martins, blackbirds, swallows, sparrows, etc., gather at night to roost in some selected grove of trees, and in the morning fly out again in search of food. "In the case of such species

as sparrows and starlings, these roosts may continue throughout the winter. * * * With the blackbirds, swallows and robins such nightly gatherings are the forerunner of seasonal migration." Birds often form permanent associations for migrating. These groups may come together for protection, but there also seems to be a social attraction.

Group territories are formed not only for (1) mutual protection and (2) social interests, but also for (3) nesting purposes. Bushtits (Addison, 1938) seem to show that group attraction carries over into the breeding season, since often the birds do not resent other birds in their breeding territory. One example is told of three birds taking active part in nesting activities. While one bird covered the eggs, the other two foraged together and collected nest material. The three birds took turns on the nest and in feeding and brooding the young. "Assistance by other birds than the mated pair is rendered in some species by juvenile helpers, by unmated helpers and by mutual helpers." With the black-eared bushtits in Guatemala, Skutch (1935) found the male and female to alternate in sitting on the eggs, but after the young hatch, the helpers that assisted in making the nest assist in feeding the young. "During incubation only the female occupies the nest, but the male has several helpers to bring food to the young." McKim (1937) tells of a siskin who, having no mate, undertook to assist some canaries with their duties. At first he assisted in feeding the birds, but later decided to have the nest and took upon himself the care of the young after driving away the parents. Of course, this went beyond cooperation and was disastrous, since he would not leave the nest to get food for the young. The meadow pipit in Brittany often nests in colonies (Mountford, 1935:463) for protection.

Rookeries of penguins, crows, rooks, swallows and English sparrows, all serve as examples of *group nesting* territories. Penguins nest in large groups, but each pair defends its individual territory, with nest and young, against its neighbors. (Pearse, 1926.) Crows not only use the rookeries during the breeding period, but, according to observers (Barrows, 1895:11) return occasionally to inspect their territory. The common crow feeds in flocks as well as nests in large groups. With rooks it is clear (Horsfield, 1923:85) that a given belt of trees is marked out as the property of a particular colony. Even when they leave their "ancestral home", as they do for months at a time, they never forget the fact of possession, and throughout the year they pay periodical visits to their "tree castles" in order to satisfy themselves that all is well. During the winter several colonies will amalgamate, but at the call of spring each party draws apart and returns to its own place, the younger members of the community being forced by lack of accommodation to "betake themselves to a nearby wood" to form a branch colony of their own. The cliff swallows' nests are placed very close together, each nest being defended against all neighbors, but the whole making a definite social territory. Here the social attraction evidently is so permanent that even sexual attraction becomes subordinate to it. (Storer, 1927:104-108.) Each individual seems to respect the rights of his neighbors in these "bird cities". (Dixon, 1917:18.) The English sparrows are almost identical to cliff swallows in their social territory, except that they are permanent residents, whereas the swallows are temporary residents in the nesting territory.

These social attractions may go further, for we find some examples of inter-specific relationships. After the breeding season various species form flocks primarily of their own kind, but also with other species. "Usually a species is attracted to birds larger than itself and disregards or tolerates smaller birds (Heyder, 1929:187-194). The mixed flocks of chickadees, nuthatches, woodpeckers and other birds, feed together and seem to be a real

social unit during the non-nesting season (Butts, 1927; Wetmore, 1934). Through much of the year these little companies of woodland birds are a regular feature of our local bird life. The nucleus of the mixed flock which may contain a dozen species, is the group of chickadees which has its regular range and does not depart far from its limits. The nuthatches and a downy woodpecker or two stay with the band, the others stay temporarily and then migrate. The sleeping quarters for such a flock vary from day to day also. (Hildebrant, 1928:125-132.) The mixed flocks of Treganza blue herons, black-crowned night herons, white-faced glossy ibis and Brewsters' egrets are found to have social territory during the nesting season only. Hall (1926:88) tells of cormorants and pelicans perching and nesting in flocks on the rocks of pinnacles at the end of Pyramid Lake. The bird colonies or rookeries on the islands of Great Salt Lake are quite outstanding (Thompson, 1932). "One finds the center of Egg Island occupied by herons and cormorants, the nests of the cormorants in one group and those of the herons in another. On Hat Island the pelicans inhabit a strip of rather level ground on the north and east portion of the island. The herons of recent years have chosen the bushes on the north and east sides only." (Behle, 1935:25; Woodbury and Behle, 1935:165.) It is not uncommon in some places to find the glaucous gulls nesting in the same colony with the herring gulls. (Gross, 1927:27.) On the nesting grounds, as well as in migration, the blue geese associate with lesser snow geese. (Soper, 1930:72.)

Still other territorial developments suggest themselves among birds. Regardless of the type of territory, defense of that territory among birds is quite marked, but its intensity varies with different birds at different seasons of the year. The song sparrow has seasonal territory. The male song sparrow takes up a rather definite area before the breeding season starts, and maintains his position during the breeding season, driving off intruding males before and after the female has appeared to accept the territory and the male as her mate. (Nice, 1933;1934.) Butts (1927:344) also observed bird territory in the song sparrows whose nests were built in a low hedge of spruce four hundred feet apart. "Each pair had a definite feeding area which was not encroached upon by the other pair." As soon as the breeding season is over the urge to defend the territory becomes less vigorous. In certain other birds, as the great-crested grebe, it is entirely lost. (Venables and Lack, 1936:62.)

Other evidences that territory is not merely a matter of space, but also a matter of time duration (Friedmann, 1933:41-45) are found among birds. A continuous or permanent territory is shown by the Loggerhead shrike (Miller, 1931:148), which is a solitary bird, except during the breeding season, and occupies and defends his territory throughout the year. With the English robin (Burkitt, 1926), the males remain in and defend their territories throughout the year. The male redbreast never leaves a territory upon which he has once bred, for more than a brief excursion. The eagle holds its territory for many years and defends it against intrusion of other eagles. (Herrick, 1934.) Mockingbirds, *Mimus polyglottus leucopterus* and *Mimus polyglottus polyglottus,* have summer and winter territories, the winter territory being defended as a personal food territory by a lone bird or even by a pair, whereas the summer territory is defended by the male as a territory for himself and his family. (Michener, 1935:97-140; Laskey, 1935:370-381.) In winter the female often has a territory adjoining that of her former mate, often a piece of his former domain, but he does not trespass. Although careless about concealing its nest, this bird is jealously anxious about intruders and attacks indiscriminately any animal. (Wood, 1892: 544.) Hawks occupy

and defend a territory by day which may be occupied and defended by owls at night. To frighten up an owl in the daytime is to bring down the vengeance of the hawks upon it. We find all gradations of time. The long-billed marsh wren defends territory, but after incubation starts the "territorial zeal weakens" and vanishes when the young leave the nest (Walter, 1935:13). In ruddy ducks (Friedmann, 1932:16) the concept of territory is very weak and disappears after the eggs hatch.

The space occupied as territory and the purposes served by such an area vary with different birds. The eagle's territory includes not only its nest locality, but also its hunting and feeding territory of many square miles, which it guards against other eagles. (Herrick, 1934; J. Dixon, 1937; Slevin, 1929: 45-71.) Boundaries of the area claimed by each pair of birds are definite and this area is handed down from generation to generation. The St. Kilda wren (Harrison and Buchan, 1935:136) has a large territory, but collects food in only a small portion of it, each parent tending to feed in exclusive food patches not used by the other. A black-bellied plover claimed and held for himself a strip of perhaps one hundred yards on which he permitted no other plover to encroach. (Michael, 1935:169.) In his notes on Barn swallows, Smith (1937) says "evidently the shed was held as territory, for when a phoebe attempted to investigate the beam at the opposite end of the structure it was driven away by the male several times for several days, and when another pair of barn swallows appeared, both birds attacked and drove them off." Davis (1937) says in his observations of swallows: "Within my barn the birds had very definite territories, though quite variable in extent. Fights always followed trespass on the territories. There seems to be a definite lessening of territorial boundaries as the young grow up." Each corn bunting holds a distinct individual territory which it holds against all comers (Ryves, 1934:6). Although nests are placed within the male's territory, feeding takes place at long distances, hence the territory of the corn bunting seems to be something intermediate between nest territory of colonial birds and typical territory of reed buntings, song sparrows, etc. Crouch (1936:2) says of the cedar waxwing: "The literature is mute concerning the nesting territory of this bird. I would judge it extends no farther than a few feet from the nest itself. It is doubtful if the cedar waxwing has any well-defined feeding territory; if they have, it is not defended. If their food supply is scarce they move to other regions." Howard says of the waterhen (1929), "The pond, with the surrounding ground, is his in the sense that he lets no other male upon it or strays himself beyond it." The ruffed grouse selects and defends a territory, according to Allen, "probably to protect himself and his household from violation by a sturdier ruffian." (McCabe, 1934:37.) The road runner seems to hunt in an established area and desert dwellers say he appears at the same spot at exactly the same hour every day. (Arnold, 1935: 94.) The male black-tailed godwit (Huxley and Montague) pursues other birds that come into its territory with great hostility, even though its territory is ill-defined.

Certain birds prepare a court or mating ground which they consider territory. Chapman (1935:472) says that the Gould's manakin considers its court the focus of a mating territory, where territorial limits are definitely recognized and generally respected. The Capercaillie males gather at leks or courts. Each defends his "mating territory". (Hainard and Meylan, 1935:291.)

Other birds have little territory except the nest which they defend. The nest is very important in the life of the white stork in East Prussia and it is strenuously defended often more so than the mate. (Schuz, 1936.) The

snowy owl is very anxious about its nest and will attack with great force any intruder, including man. (Murie, 1933; Wetmore, 1935.) The western goshawk resents intruders to its nest and made things very unpleasant for the Dixons (1938:3-11) when they were attempting to photograph the nest. The black-headed gull (Kirkman, 1937), having once selected a nesting site, holds on to that particular spot with great tenacity. Coots are pugnacious in the nesting season and sometimes vigorously resent intruders, even of other species, on their nesting territories. (Munro, 1937.)

That territories may be separated by vertical as well as by horizontal extent was found by Williams (1936) when he mapped many bird territories in his study of a Beech-Maple community. He states the case of a red-eyed vireo's nest, seventy-five feet up in a beech tree, while almost directly below it was a nest of a second pair in a beech sapling six feet from the ground, one thus having "a tree-top territory, while the other had a ground-level territory."

The bird population determines the extent of other bird territories. With the Dartford warbler (Venables, 1934:58-63), territory varies with density of population. When the population is spread out the birds seem to be strictly territorial, but when thickly distributed, sharing takes place without friction. So Venables says, "It is clear that with the Dartford warbler, territory does not limit the population density and does not restrict the feeding area." Dr. Palmgren (1932:61-94) found that chaffinches and golden-crested wrens had distinct territories, but where the birds were more abundant, territories were not so clearly defined. In cowbirds (Friedmann, 1930), individual territories are not associated with food supply, but with abundance of nests in which to deposit eggs, thus the denser the small bird population the smaller the territory of each cowbird. In parasitic cowbirds, the birds seem still to have the "territorial desire", but have lost the instinct to protect breeding areas.

Another restricted territory is shown by individual birds in a social group. It has been observed with Bonaparte gulls (Twoney, 1934:291-296) that both parents strenuously resent any intruders from the egg-laying time onward. Each pair of herring gulls has a rather sharply defined breeding territory even before the nest is built (Pearse, 1926), and it is defended by both birds until the young are fledged. Here we have a colonial bird that is also a territorial bird. The double-crested cormorant is strictly a colonial nesting bird, although each bird claims territory (Lewis, 1929). The guillemot, which nests in colonies, has but a few square feet of territory, the principal object of establishing a territory being to secure a suitable nesting site. (Butts, 1927:330.) Pigeons have territories, just as do non-gregarious birds, but their territories are more restricted and fluctuate, the size being affected by the space available and the density of the population (Taylor, 1932:127-131). Birds whose territories adjoin tolerate each other, whereas they furiously drive away less familiar birds. If one pair occupies a pen, it will claim the entire territory and treat any newcomers as intruders.

The strength of the territory urge varies with different birds. From the strong, continuous or permanent holding of territory of the eagle, shrike and English robin to the very weak or short-lived urge of the ruddy duck and a great-crested grebe we have many graduations of length and strength. In the Cape Cod Sterninae, both sexes arrive together, choose mates and a territory, but territorial rights are not strictly enforced until later. As incubation progresses, territorial relationships become more pronounced. (Austin, 1932:123-139.) With the hobby (Schyll, Tinbergen and Tinbergen, 1936: 388) the hunting territory is not defended, only the vicinity of the nest. With bushtits the instinct to defend a selected territory during the nesting period

must predominate over the instinct to flock together, which is so conspicuous in the behavior of these birds during the rest of the year. (Robertson, 1935:257.) After the arrival of a mate, the male wood warbler restricts his activities to a smaller territory than before, but defends its more vigorously, driving out *all* other birds. (Mountford, 1935:495.) During the building season, the house wren sings, fights and builds with equal energy and drives away birds three times his size. (Wood, 1892:337.) The brown towhee (Ritter and Benson, 1934:170) expends a great deal of energy in defense of its territory. Blackford (1935) observed a yellow warbler defend his territory against another yellow warbler in a most vigorous fashion. The yellow warbler adult birds protect young and defend with undaunted courage. (Wood, 1892:532.) The brown thrasher (Erwin, 1935) establishes and defends territory. The nest which the yellow-breasted chat defends with great skill and courage is very well concealed. (Wood, 1892:540.) Flycatchers patrol their territory. (Dixon, 1917:44.) The white-eyed flycatcher is so jealous when engaged in rearing its young (Wood, 1892:248) that it often betrays its nest position by scolding as soon as the nest is approached. If other birds

Fig. 6. Interesting method of helping young. Some ride the water current, others ride the mother's back.

Used by courtesy of the W. K. Kellogg Bird Sanctuary of Michigan State College. Photo by M. D. Pirnie.

disturb the Egyptian vulture or come into his territory, he soon drives them away. (R. Dixon, 1917:38.)

This urge extends into that of protection of mate, young and eggs. The eagle will jealously defend her eggs and young against enemies. (Herrick, 1934.) Male penguins fight fiercely and the winner courts the female. During the breeding season there is great rivalry for nests, with many quarrels over ownership. After the young appear there is still greater rivalry to brood and care for them. (Pearse, 1926.) Adult duck hawks have been found to exhibit great anxiety for their young and not to hesitate in swooping down in defiance of human intruders. (Gross, 1937:22.) The male bobwhite will fight hard battles for his mate and once mated he is "loyal to his wife and family". (Arnold, 1935:248.) Male partridges and ganders protect their young (Finn, 1931:116) and the male hornbill takes care of his imprisoned family. (Duncan, 1926:226.) Some birds brood their young on the back under the wings (Finn, 1931:114), like the common mute swan female, or both parents of the South American black-necked swan. In grebes the young are habitually carried this way on the back of the swimming parent. It was once observed that while one parent bird carried the chicks, the other hunted for food.

"It is quite impossible that the defending bird should always be the strongest and in the vast majority of such encounters domination is determined by factors quite other than physical vigor. It may be even that territory has its chief value in protecting the individual and his household from violation by the sturdier ruffian at the gates." (McCabe, 1932.) Mendell (1936:202) observed one immature male double-crested cormorant as it established terri-

Fig. 7. A colony of cliff swallows' nests; placed very close together, each nest being defended against all neighbors, but the whole making a definite social territory. Photo by Dr. Walter P. Cottam.

tory and built a nest. When, after much difficulty, it completed its nest it guarded jealously and "was as particular of his territorial rights, as were the mature adults". However, another point concerning protection might be considered here, that is, it seems that birds of monogamous parents are better protected than those of polygamous parents, probably because the former have two parents to protect them and the latter have but one, that being the weaker of the two.

Cooperative defense of territory is shown by a large group of birds. Weaver birds that nest in colonies of several hundred nests are very active in defense of their territory against intruders into the colony. (Wood, 1892: 204; Manuel, 1935:198.) Large groups of purple martins will sometimes attack an eagle to banish it from their territory. (Huxley, 1930:473). Tomkins says of the Eastern willet (1938:14-16): "Birds come from all directions at the first distress call and bombard the intruder with all manner of invectives." Sparrows often attack crows. A group of small birds will combine to attack a common enemy, such as an owl or hawk. (Dixon, 1917:152.) The example (Leach, 1927:233-238) of the eight or ten California woodpeckers which lived as a colony with headquarters in an oak tree, and which did not permit others of the same species to trespass is another example of defense of territory shown by a group. They worked on a nearby pole in rotation, incubated the eggs in turn and several adults fed the young.

There has been some work done (Whittle, 1932:107) on the factors bearing on whether young birds return to the place of their birth; e.g., (1) great loss of juvenile birds the first year; (2) high returning ratios of old birds; (3) old males precede young to the nesting grounds and preempt territories; (4) scarcity of nesting territories for nesting sites. It is probably the general rule that living adult birds return to the same locality to nest year after year, but in immature birds there is a tendency to dispersal (Kendeigh and Baldwin, 1937:123), because of lack of space. The wild turkey prefers nesting in the same section of country in which it was born. (Rutledge, 1935:203.) The male ovenbirds return to their old breeding grounds year after year if possible (Hann, 1937:147). Hall (1926) says of the great blue herons of Pyramid Lake: "On the very apex of this pyramid a pair of great blue herons nest regularly every year." The double-crested cormorant selects a nesting site usually near the nest of the previous year. In fact, a colony of these birds usually uses the same general site year after year. (Lewis, 1929.) Crows, gregarious birds, roost in huge communities year after year, selecting the same locality (Barrows, 1895:10.) The boat-tailed grackle returns to the same nesting locality in succeeding years (McIlhenny, 1937) as does the Minnesota marsh hawk (Breckinridge, 1935:269). The bald eagle nests in the same tree for years (Wood, 1895). The golden eagle holds a definite area for his own and boundaries are definite and handed down from generation to generation. (J. Dixon, 1937:51.) Herrick (1934) says of the American eagle: "The eagle's eyrie is not only a cradle and bed chamber for its young during three months, but it is the home and castle of the mated pair for many years." Shrikes regularly nest again in the same territory, although not often in the same bush or tree. Carter (1928:119) observed an identical nesting site occupied by a loggerhead shrike for ten successive summers. Crows and rooks (Wood, 1895) return to the same domicile every season. Song sparrows (Nice ,1932) usually return to their former nesting places. Chickadees often nest for successive years in the same territory (Butts, 1931:25). According to VanTyne, the nest cavity of the Toucan is used year after year by the same pair of toucans (Gross, 1930). Usually the old nest is adopted by the white stork in East Prussia when it arrives at the beginning of April (Schuz, 1936). Marples (1934:187-203), in his "Winter Starling Roosts of Great Britain," tells of nineteen roosts which have been occupied for forty

years, one for one hundred thirty-five years and one for one hundred eighty years. Observation of barn swallows (E. M. Davis, 1937:67) indicate a strong tendency to use an old nest or foundation rather than build a new one the next year. The house wrens were found to return to the vicinity of the original nest in the majority of cases. (Baldwin and Bower, 1928:191.) Cormorants on Egg Island in Great Salt Lake build anew on the old nest year after year, some nests becoming two or three feet high. Shearwaters (Lockley, 1938:273) return year after year to their nesting site and seemingly are paired for life.

Food as a property object is important with birds. Of course, the majority of birds migrate. This necessitates internal storage of food in the bird's body, but it also avoids external food storage in such birds. Some birds, mainly permanent residents, show evidence of external storage of food, but only in a rather elementary stage. It does occur, however, quite definitely among several species, notably the woodpeckers, the jays, the shrike, and such sea birds as the gannets. (Beaglehole, 1932:92.)

Food storage by woodpeckers is shown by the following examples. The woodpecker, *Melanerpes formicivorus*, digs small round holes in the bark of the pine or oak and fills each of these with an acorn so tightly fitted that it is with difficulty extricated. The bark, when thus filled, presents at short distance the appearance of being studded with nails. The red-headed woodpecker in Indiana stores beechnuts in every conceivable situation—the cavities of decayed trees, clefts in gate posts and even the thatches of houses. "These birds have also a tendency to store grasshoppers as the California woodpeckers store nuts. These insects are captured with as little injury as possible, borne to some old oak tree or post and there wedged in between the crevices and left struggling vainly to get free. As many as a hundred grasshoppers have been found as wedged at one time. Later, the birds return to devour their victims." (Pycraft, 1910:141-142; Beaglehole, 1932:67.) Another woodpecker, *Colaptes mexicanus*, stores food in the interior of a plant which is abundant in the region it inhabits. Insectivorous during a part of the year, it is forced to renounce this diet during the dry season. In the regions of Mexico where this bird is found the dry period is so absolute that it would die of hunger had it not a store of food collected during the spring to fall back upon. Acorns are stored in aloes, yuccas and agaves, or in the shrivelled stem cavity of an agave. In time of plenty it lives on insects and fruit; in time of scarcity, mostly on nuts. (Beaglehole, 1932:67.)

Examples of other birds that store food follow. The North American blue jay stores acorns and beech nuts for food for winter. The nuts are usually inserted into all sorts of crannies in trees, fence posts, fence rails, and deserted buildings. (Finn, 1931:309.) A caged pair of nuthatches not only stored sunflower seeds in the chinks at the back of their large cage, but even live spiders were jammed ruthlessly on the wires and left to kick themselves to death. (Finn, 1931:309.) The shrike stores food by impaling it alive on stakes, thorns or barbed-wire fences. Owls often accumulate a quantity of prey in their nesting places, which, unlike most birds, they use as permanent homes and not merely as temporary homes or nurseries during the breeding season.

A few sea birds show food storage. Most sea-birds live all year round in close proximity to their food supply. They are rarely found far from the sea or river estuaries and thus have no occasion to store food. Gannets, however, frequently fly fifty miles to their fishing ground. In spite of the labor involved, they invariably collect far more food than they need. Ogilvie (Beaglehole, 1932:70) has suggested that the explanation of this accumulation activity is to be found in the fact that gannets feed on surface-swimming fish and

are thus dependent for their food supply on the state of the weather, since the fish swim at greater depth when the weather is uncertain and stormy.

Some birds make a habit of obtaining their food by robbing their weaker brethren. In all cases the victim puts up as prolonged a resistance as possible to attacks of robbers. (Beaglehole, 1932:81.) The robber tern gains its food entirely by plundering other terns. The frigate bird is a professional robber, who attacks boobies, not only making them drop the fish they have caught, but also causing them to disgorge the food actually in their stomachs.

Birds, in the majority of cases, are not called upon actively and continually to defend their food supplies, but should the occasion arise they are usually as willing as they are successful in the maintenance of an exclusive right to that which they have gained by their own labor.

The evidence seems to point clearly to the fact that property among birds includes mate, eggs, young, food and territory, all of which are protected and to which rights are maintained for varying lengths of time.

Birds show certain advances over the reptiles in their development of property rights. These advances include:

1. Better food storage in the egg for the developing embryo;
2. Better shells on the egg;
3. Better nests, reaching to elaborately organized structures;
4. Better incubation of eggs;
5. Tending of young in the nest and out of the nest;
6. Feeding of young in nest and out of nest;
7. Beginnings of external food storage;
8. Spread of territorial organization to the majority of the population;
9. Development of parent, family and group territories;
10. Further development of property urges for eggs, nest, young, mate, and territory;
11. Family and flock social organization.

The property rights are indicated by the following attractions:

1. Insurance of fertilization: attraction of one sex to another—internal fertilization—promiscuous, polygyny, polyandry, monogamy.
2. Care of eggs:
   a. Burial in mound of decaying vegetation;
   b. Nest building, varying from lined holes in ground to elaborately woven structures;
   c. Incubation of eggs by one or both parents;
   d. Guarding and defending nest and eggs.
3. Family care:
   a. Care of mate.
   b. Care of young:
      (1) There appears to be no attraction between parents and young among the primitive mound builders and brush turkeys;
      (2) Direct tending without feeding by one parent, or both (precocial);

(3) Direct tending, including feeding by one parent or both (altricial);

(4) Direct guarding and defending in the nest and out of the nest.

4. Territory: Practically all birds show some form of territorial claim which may be classified as follows:

a. Territorial organization.

(1) Solitary.

(a) Seasonal feeding, e.g., shrike.
(b) Breeding, which may expand into (2)

(2) Pair territory.

(a) Feeding—seasonal—nuthatch;
permanent—Nuttall white-crowned sparrow.
(b) Breeding, which may expand into (3);

(3) Family territory;

(a) Nesting;
(b) Feeding;
(c) Wandering—(losing restricted territorial urge).

(4) Flock territory: flocks may consist of

(a) males alone,
(b) mother families
(c) father families,
(d) parent families,
(e) aggregations of individuals.

These flocks may be either

(a) intraspecific,
(b) interspecific,

and may be used for the following purposes:

(a) feeding,
(b) sleeping,
(c) nesting.

b. Territorial facies (restrictions).

(1) Time.

(a) Day territory.
(b) Night territory.
(c) Seasonal territory.
(d) Alternate—summer and winter territories.
(e) Permanent territory.

(2) Space.

(a) Horizontal—area.
(b) Vertical—strata.

(3) Cooperative defense.

(a) Sentinels.
(b) Mass attack, e.g., purple martins attacking eagle.
(c) Closed society, e.g., woodpeckers.

5. Food: Most migratory birds avoid external food storage problems by storing food internally as fat, but some permanent residents store food externally and sometimes defend their stored food.

Property Rights of Mammals

Mammals show definite sexual attraction and internal fertilization, and have retained and improved the reptilian method of embryo transformation through the aquatic to the terrestrial stage, but show various stages of abandonment of the mass storage technique of reptiles in favor of progressive internal feeding. They, like the birds, show development of courtship into a ritual. They all show some care of the offspring; particularly suckling of young after birth for varying periods of time, but also show various stages of further care of young after weaning.

There are a number of variations in the behavior of mammals: (1) from the oviparous (egg-laying) habit of the monotremes to the viviparous habit of most mammals; (2) from the seasonal attraction of one sex for the other to a continuous attraction; (3) from a seasonal production of young to a non-seasonal production of young ;(4) from the production of litters of many young at a time to the production of a single offspring at one time; (5) one offspring can naturally receive more individual care from the mother than can a litter, so we find with decrease in numbers we have increase of parental care. Along with this we have (6) a lengthening of the period of maturity from a few weeks in mice to many years in man. (7) Going along with a longer period for maturity we find an overlapping of offspring in families in which there are several young ones of different ages in one family. Carpenter (1935:179) tells of red spider monkeys in Panama in which the juveniles associate closely with their mothers long after the birth of a sibling. This is also rather a general characteristic with the great apes. Man, himself, shows this type of family relationship.

It is certain that mammals take an interest in the care of their families. There is evidence that a male will care for his mate and may consider her as his property. The common red fox, during the first week or so after the young are born, brings food to the mother fox, although he is not permitted to enter the den himself. The male red squirrel seems to consider his mate as property, for he has been observed (Hatt, 1929:15) to drive away other males even outside the breeding season. Ruth D. Svihla (1930:53) says of the golden harvest mouse: "Two females, when placed in the same cage with but one male, fought quite savagely. Two males placed together got along very well until a female was introduced into the cage." Rivalry for ownership of a mate seems to be the explanation.

With regard to care of eggs and young, the duckbill, *Platypus,* lays eggs and brings up her young in the shelter of a burrow brooding them birdwise. (Pycraft, 1913:7; Miller and Gidley, 1934:276; Holmes, 1939:273.) The viviparous mammals show great interest in their young and have various ways of caring for them. The kangaroo, a marsupial, is provided with a more or less pocketlike fold in the skin of the abdomen of the female, within which the immature young is carried and nourished as soon as it is born, and until it is mature enough to take care of itself.

Nests are built as a refuge for the young of such mammals as the tree squirrels, mice and some others. Cowan (1936:60) noted that the female flying squirrel has her own nest for herself and her young, while the male has his nest near at hand in case of need for protecting his family. Tree squirrels inhabit hollows in trees or sometimes in holes among their roots, and in summer make globular nests of leaves and twigs in which the young are nursed and cared for. The nest of the Alaska red squirrel undoubtedly serves as a home for the young in the spring as well as for winter shelter. (Murie,

1927:39.) The harvest mouse makes a cozy nest to protect its naked, helpless young. (Shoosmith, 1937:202.) On the island of Java are found a family of strange, dwarfish mammals called malmags or hobgoblins, which rear their young in hollow roots of bamboo trees. (Dixon, 1918:195.)

Other mammals dig burrows in which the young are born, fed and cared for. The young rabbit is born in a warm and sheltered burrow; so also is the young woodchuck. The red fox also bears its young in its well-made burrow which has a large nest chamber. (Schmidt, 1934:49.)

Most mammals have a place which serves not only as a refuge for the development of the young, but also as a place to hold and train the young. The adults guard and defend the abode and their offspring in it against intruders. In telling of a ground squirrel, *Citellus lateralis*, which was a pet in a summer camp, R. L. Ives (1935), says, "Although she was not in the least timid about most things, nobody could come near the young ones without getting bitten." Johnson (1927:114) found the female prairie dog, *Cynomys ludovicianus*, in captivity to be very solicitous of her young and to bite at the fingers of her attendant when the young were touched. Male seals defend their mates, young and territory, against enemies. (Bartlett, 1929.) The mother hood seal will fight for her young and the dog hood seal will hang around and defend his family. When a male mouse of genus *Peromyscus* is placed with a female following the birth of a litter, fighting usually results, probably because she considers him as an interloper and fights to protect the young. (Svihla, 1932:10.) Female bears are extremely solicitous of their cubs and heedlessly brave in their defense. The cubs at birth are surprisingly small, and are naked, blind and very slow to develop. (Ingersoll, 1922:338.)

Certain mammals tend their young; for example, the mother cat will move her kittens from place to place, and the female bat carries her young on her back as she flies. Among mammals it is a curious fact that when the young is carried the burden is undertaken by the female, the male rarely taking any part in the work of tending the offspring. (Pycraft, 1913:19.)

Direct training or instruction imparted by the parents to the young is given by some mammals. Cats certainly train their young in the art of mouse-killing; young lions are as certainly trained to slaughter, accompanying their parents in the search for food till long after they are full grown, and receiving constant instruction in all the arts of seeking cover, the final spring and methods of dispatching the victim. (Pycraft, 1913:25.) The kittens of the Canada lynx accompany the mother on her hunting expeditions and are taught "to crouch and climb, to lie in ambush and to leap swiftly and surely on the prey." (McGowan, 1936:202.) A most interesting example of training the young by its parents is that of the adult otter teaching its its young to fish. (Tregarthen, 1900:10-20; Schmidt, 1934:50.) The mother and young fish together until the juveniles have been taught to swim rapidly, dive neatly and have "learned how to cope with a frog or a whitefish." (McGowan, 1936:54.) "Much of the success of the coyote has been due to the fact that the parents provide the offspring with a first-class education, teaching them how to hunt singly and in pairs, to take cover and to resort freely to strategy." (McGowan, 1936:143.)

The organization of the territories varies with different mammals. Among many of them we find the males are solitary, except at the mating season. The male mink is a great wanderer, while the female remains in a more restricted area even after her young leave her. (Marshall, 1936:385.) The male grizzly (Seton, 1929) mates with one female; they continue together for about a month and then they part for good, so most of the time he is a solitary animal. He knows his home territory and occupies it year after year and

sees to it that no other grizzlies use it, although other animals, such as mountain lions, squirrels, etc., are not resented. (Mills, 1923:252.) The koala of Australia (Lewis, 1931) seems to prefer a solitary life even where fairly abundant. Months ago a number of these animals were placed on an island for their better protection and when visited later they had scattered over the whole extent of the place, none being closer than two hundred or three hundrd yards to another. The rhinoceros is solitary. It is said that if two are found together it is the mother and her calf, as these animals are extremely unsociable. (Hubbard, 1939:1-20.)

Pair territories are found among mammals. The coyote territory might truly be considered a pair territory, for coyotes run, hunt and live together in pairs. (Seton, 1929. It has been said (Seton, 1913:5) that "the coyote is an exemplary little beast who has only one wife, he loves her devotedly, and they fight the battle of life together". A pair of wildcats take up a rather small hunting territory, but this they will defend against invasion. (Dixon, 1918.) The grizzly territory, which is solitary through most of the year, becomes a single pair territory for a few weeks. These pair territories become mother family territories during the breeding season.

Family groups are the rule among mammals, but they may be of different types. Parent families are found in many cases. The parent "family is the social unit of the orang-outans". (Yerkes, 1929:137.) The jaguar family is a parent family, both male and female feeding, protecting and training their offspring. The red fox territory is a true family territory, both parents feeding, tending and training the young. (Schmidt, 1934:49; Grinnell, Dixon, Linsdale, 1937:394.) The male lion (Alverdes, 1927:64) procures food for the young, and protects his family. Other animals, such as the cat, mountain lion, deer, sheep, cattle and beaver are mother families, since the mother, unassisted, guards the young. (Beaglehole, 1932; Alverdes, 1927.) These family groups have their territories for feeding, hunting, sleeping or other needs.

Groups larger than family units exist among some of the mammals. These large groups of animals usually travel over an area of country known to them, and other groups do not interfere. Monkeys almost invariably constitute bands, as do gibbons and gorrillas. In polygynous mammals, such as wild horses, the animals remain in a herd after the young are able to travel well. Among wild reindeer (Alverdes, 1927:81) the young males and females, not yet capable of reproduction, join together into herds of considerable size, led by an old unmated female. Such groups are called "child families" by Alverdes (1927:71). The Alaska-Yukon caribou (Murie, 1935:28) is a highly gregarious animal. The individual herds are designated by the territory principally occupied by each. The have summer and winter range and are not disturbed by others, for they have their own particular range. The prairie dogs (Johnson, 1927:112) and the California ground squirreds (Grinnell and Dixon, 1919:599) have regular cities of holes, but they respect each other's rights. The vizcachas of South America rule their underground cities according to definite laws and never intrude upon the domain of their neighbors. (Dixon, 1918.) Territorial arrangement was found to be the condition with the nests of wood rats. (Durrant, 1934:65.) "The nests were relatively evenly spaced over the occupied area as though territory rights were here observed."

Group territories are sometimes feeding territories, such as exist with elk which in winter congregate together in small groups in spots where forage and cover are available. (Seton, 1929.) They also travel together in small bands, usually composed of one or two bulls and three cows and their calves. (Orr, 1937.) Mountain sheep feed in groups in a definite area and have a

sentinel. (Seton, 1913.) Alverdes (1927-46) says that "each herd of kangaroos possesses its own grazing place, sometimes several linked together by well-trodden paths".

Certain groups of mammals have closed territories in which no other animal of the same species is allowed. In oriental cities every alley has its own pack of half-wild dogs which do not permit another such dog to enter at any time. If a dog enters a strange alley, he is attacked and torn to pieces unless he can retreat rapidly enough to get back to his own domicile. (Alverdes, 1927:111.) Every horde of apes has its own well-defined domain, which it defends against other hordes of apes (ibid, 161).

Group sleeping territories are found among bats. Bats become attached to their homes and show real homing habits. (Mills, 1923:54.) They have been known to "return to their home cave or attic for distances up to sixty-five miles". (Perry, 1938.) This has been tested with banded bats.

Territories in mammals, although not so evident as in birds, show great variety in kind, size, location and defense. The fierce struggle for existence and the area required for an animal's home largely determine the amount of effort he makes to seize and hold certain possessions. (R. Dixon, 1918:189.) Some animals lay out and obtain recognition for boundaries of their ranging ground and they show respect and recognition for rights of way. Animals on certain farms seem to know exact boundaries of their pastures and grazing range. (Dixon, 1918:190.) Leopold (1933) states that a piece of land, to be habitable for game animals, must offer places for "suitable feeding, hiding, resting, sleeping, playing and raising young". He goes on to say that "the essential difference between a deer and a man is that man builds farms, factories and cities to provide himself the elements of a habitable range, whereas a deer must accept the random assortment laid down by nature or modified by human action. . . . In both cases it is essentially a struggle for the best places for food and cover. They vary according to season and circumstance." * * * "As in the case of *Homo sapiens*, some of the properties of game species are not discernible in the individual bird or mammal, but become apparent only through the study of large aggregations of individuals or game populations." Such properties as the tolerance of one species for another and the minimum unit of range a species can occupy are shown by large groups such as deer herds.

Certain mammals seem to take possession of a territory and remain there year after year. Rutledge (1935:202) says: "I know one doe * * * to raise three fawns in successive years in the same stretch of solitary woodland. I knew one buck fawn born here to make it his home until, as a stately ten-pointer, he went the way of great bucks." Joseph S. Dixon (1934) found in some instances that a given individual deer could be found day after day in a relatively small area. An old doe, when approached within a distance of six feet, laid back her ears and struck at an intruder with her fore feet. However, after the rutting season is over, older bucks lose their antagonistic attitude toward each other and sometimes show a friendly feeling. Groups of spider monkeys in Panama (Carpenter, 1935) range over a limited and specific area within which they are semi-nomadic, but independent. MacGillvray (1928) says that old beavers are apt to maintain the same home year after year, and that they will fight to the death predaceous animals that attack them. The muskrats add to and use the same home for a number of years, and such homes become rather large. These animals like company of their own kind. (Mizelle, 1936:661; Svihla, 1931:126.) One squirrel occupied a given pine tree for five years or more, and promptly ejected each invading squirrel that came to his area. (Mills, 1923:152.) Wood (1892) says it is not an easy matter to drive out rabbits from any place of which they have already

taken possession. The chipmunk, too, is quite tenacious of its holdings. It has been said of bats (Howell, 1920) "when a particular site is chosen, a little use will fix the bat scent, and it will always be selected thereafter. An abandoned roost is rare and it is almost impossible to drive tenants from a favorite home". The gray fox (Dixon, 1918) sticks to one general locality, although his hunting grounds may range for several miles in all directions. The tendency for prairie deer mice and forest mice to remain in a definite locality and return to it even though carried two hundred yards away, was discovered by Johnson (1926:262).

A definite food territory is claimed by the red squirrel, *Sciurus hudsonicus*. He has a restricted home range in which he "knows every limb and jump from one tree to another". (Hatt, 1929:49.) He is a solitary creature through most of the year, since the necessity for storing up food for winter has developed in him a sense of ownership and independence. If one squirrel attempts to steal from the stores of another squirrel, the latter protects his property with great spirit. The red squirrel owns and controls "trees that bear nuts and cones, and others respect his rights and do not invade his territory unless there is a famine." (Murie, 1929:39.)

Definite breeding territories are occupied by some mammals. It is well understood among able-bodied bull fur seals (Romanes, 1912:345) that each one shall occupy a certain plot of ground, provided he can hold it against all comers. Preble says that in May the old bulls come out of the sea and pick a station, often a previously occupied spot, where they await the arrival of the females, and stand guard. Smith (1911) says that "he maintains a most vigilant watch over his harem and is always ready to repel invaders". The kangaroo territory becomes a breeding territory "when pairing time begins". The male kangaroo claims all the females belonging to the herd of which he is the leader, but not without fierce struggles with other males. (Alverdes, 1927:46.)

The establishing of dominance is found among animals. Dr. Uhrlich (1938) found that there is a tendency for one "boss" mouse to establish dominance over other males. His rule may last for several months or only a few days. It has been found that chickens and pigeons (Masure and Allee, 1934: 306, 337; Murchison, 1935), black-crowned night herons (Noble, Wurm and Schmidt, 1938:40), some lizards (Evans, 1936:88-111) and fish (Noble, 1939: 113-126), all show dominance. The burro fights for leadership and power (Arnold, 1935:9). He fights every other jack to be "head man". Burros "even take possession of water holes and will not let cows drink". Murie (1934:16) noted that "at a lick where a salt block had been placed, only one animal (moose) fed at a time". One particular cow, when approached by another cow or a young bull, lowered her ears and rushed at the intruder, thus showing her idea of rights over the salt, although they were only temporarily exhibited. Hatfield (1935:261-271) says of meadow mice, *Microtus californicus*, "It is advisable that the pair be put in a strange cage rather than in either of the original cages, since each mouse considers his semi-permanent cage as his private property to be defended against any intruders," and they are vehement fighters. Hall (1927:197) says of the house mouse, "They are inter-individually repellent when not migrating," but as soon as they leave the home range and have no property rights to defend, they do not repel each other. Even the rat seems to lay claim to its cage and all that is placed in it. If another rat is placed in the cage and food is given, the original rat has primary right to the food, the other animal is not allowed any. If the rats are moved to the cage of the second rat, the priority is reversed. This was tried with several rats many times and always worked the same way.

Such animals as the flying squirrel make their nest territory a definite refuge for the young. The red fox burrow is a real refuge for the baby foxes which are born blind and helpless. It remains a refuge during the time they are going through the kindergarten stage and until they are mature enough to live and hunt for themselves. (Schmidt, 1934:49.)

Some mammals have alternate territories, occupying one area in the summer and another in the winter. The Alaska-Yukon caribou herds have summer and winter range. Deer occupy different territories in summer and in winter. The moose, which is not a herd animal, and which comes and goes irrespective of other individuals, sometimes yards up in small groups in winter. The group restricts its wanderings to a very limited area if food is plentiful. (Murie, 1934:16.) Cave bats have alternate territories. They spend their hibernation period in winter in caves, and their summer in regularly established roosts, such as in attics or old buildings.

Permanent territories are maintained by such animals as beavers. It is not uncommon for a beaver to be "born in the house built by his grandfather". (Mills, 1923.) The territories of grizzlies are also permanent.

Animals, as a rule, are not only able to produce offspring, but also have a means to aid in their survival. Unless hibernation occurs, the urge to store food for individual and family needs develops in mammals, and clearly marked property rights are demonstrated. (Alverdes, 1927:162.) Many mice lay up stores of grasses, straw, nuts, seeds, etc., for winter time, when there is a scarcity of food. Seton (1929) tells of the gopher storing up grains, grass roots, leaves and stems in the passageways of its burrow. Ives' (1935) pet ground squirrel had the "instinctive trait" of storing away food for winter. "Once we filled her pouches with twelve peanuts in each side. She had trouble walking with such a load. * * * She would store as many as two hundred peanuts in a morning."

The squirrel is usually active in storing for time of need. He is ordinarily a hermit (Mills, 1923:152) and has a territory and a tree to himself, and there are no trespassers. The red squirrel, *Sciurus hudsonicus*, has three sources of food supply; (1) stores of food that its puts in hollow trees or underground, (2) mushrooms stored in forked branches of trees, or pinned to pine needles, (3) green outer bark of poplar or aspen. (Seton, 1929.) The Canada fox squirrel, before burying a nut, seems to lick it, thus seeming to establish ownership. (Seton, 1929:iv, 91.)

Such animals as beavers and muskrats store food. The mountain beavers, although in crowded groups, never have a real colonial life; they resent their neighbors. (Scheffer, 1929.) These animals do, however, collect and dry bundles of green plant food, herbs, etc., which are afterwards stored in underground burrows. True beavers have permanent territories, at least for many years, if there is a good food supply, and provide stored food for their family. (Warren, 1926:182.) Arthur Svihla (1931:71) says that "from the appearance of the well-worn trail and the old stumps," the beavers he observed had known a certain aspen grove for many years. A family works together to cut and fell trees. (Dixon, 1918:89.) The branches are cut off and taken to the beaver lodge to be stored, either by being sunk in the mud at the bottom of the pond or by being piled up as brushwood on the surface. Muskrats (Mizelle, 1936:661; Svihla, 1931:126) store dried grasses, sedges and bullrush roots in their houses for winter use. The cony not only stores this grassy material, but it makes its nest in the middle of its stores. Piping hares also store "great stores of hay". (Alverdes, 1927:163) for times of need. Marmots live quite independently of each other in summer, but in winter congre-

gate together, because conditions are more favorable, and they have stores of plant food in these winter nests. (Dixon, 1918.) The wood rat not only stores food, but also collects curiosities in its nest.

Some carnivorous animals store food, but their food, because of its nature, is rarely stored for more than a few days at a time. The well-fed domestic dog will bury surplus bones. The fox invariably buries the remains of his kill. One observer claims that during the summer the fox lays up a store of wild fowl eggs for winter consumption. (Beaglehole, 1932:108.) The Arctic fox makes many caches of eggs, scraps of food and lemmings, marking each with its own sign, the odor of its protometric gland (ibid). The grey wolf, the cougar, the coyote, the marten, the jaguar, the lynx, the puma and the leopard are all carnivores which store surplus food in caches underground, covered with grass or brushwood, or fastened to the branches of a tree or a bush. (Seton, 1929.)

Apes do not store food, probably because they are naturally animals of the tropics and food is always abundant. They do "desire exclusive possession" of the objects which are of value to them. (Alverdes, 1927:162; Beaglehole, 1932:117.) We infer this from the fact that they show anger at any attempt to remove such objects from their possession. Romanes noted in his capuchin monkey that "anything he sees we do not care about he soon leaves again; but if it is an article of value * * * which he sees we are anxious about, nothing will induce him to give it up". Social competition seems to make the object more valuable. Thus it would seem that mate, young, home, territory and food, and perhaps other objects, are property factors, and evidences of the exercise of rights over them are to be found among mammals.

The mammals show increased advancement over other vertebrates by:

1. All giving some care to offspring,
2. All suckling or nursing their young and in their variation from
3. Mass storage of food in the egg to progressive feeding of embryo,
4. Oviparous (egg-laying) to viviparous habit,
5. Seasonal to continuous sexual attraction,
6. Seasonal to non-seasonal production of young,
7. Multiple births (litters) to single births,
8. Tandem litters to overlapping offspring,
9. Seasonal to long-term parental care,
10. Seasonal to long-term period of maturity.

The property rights of mammals are indicated by the following attractions:

1. Insurance of fertilization—attraction of one sex to another—internal fertilization—promiscuous, polygyny, monogamy.
2. Care of eggs:
   a. Protection in burrows by oviparous monotremes.
   b. No question of property involved in eggs of viviparous forms.

3. Family care:
   a. Care of mate.
   b. Care of young.
      (1) Carrying young in pouch in female (marsupials).
      (2) Building nests, e.g., mice and tree squirrels.
      (3) Digging burrows, e.g., ground squirrels, beavers.
      (4) Feeding of young-suckling from mammary glands.
      (5) Guarding and protecting the young.
      (6) Tending the young, e.g., bat carrying young, cat moving kittens.
      (7) Training young, e.g., otters teaching young to fish.

4. Territory:
   a. Organization.
      (1) Solitary—feeding, e.g., male grizzly, rhinoceros.
      (2) Pair—feeding.
          breeding, may expand into (3).
      (3) Family—
          (a) Parent family.
          (b) Mother family.
      (4) Group territory—
          (a) Bands, e.g., monkeys.
          (b) Herds, e.g., wild horses.
          (c) Child families, e.g., wild reindeer.
          (d) Feeding, e.g., elk in winter.
          (e) Closed, e.g., oriental wild dogs, ape hordes.
          (f) Sleeping, e.g., bats.
   b. Kinds.
      (1) Food territory, e.g., red squirrel.
      (2) Home or abode, e.g., beavers.
      (3) Breeding, e.g., seals.
      (4) Refuge for young, e.g., nest of flying squirrel.
      (5) Alternate, summer and winter, e.g., deer.
      (6) Permanent, e.g., beaver, male grizzly.

5. Food.
   a. External storage in—
      (1) Burrows, e.g., rats, mice.
      (2) Hollow trees, e.g., tree squirrels.
      (3) Nests (hutches), e.g., beaver.
      (4) Dens, e.g., fox, coyote.
      (5) Ground, e.g., dogs.
      (6) Under rocks, e.g., hay piles of conies.
      (7) In ground litter, e.g., cougar.

Human Property Rights

As the animal groups become more social they become more cooperative and there is less evidence of individual defense of property. However, in time of need a whole group will combine its energy for a common good. Each animal may have its rights, and property which is recognized by other individuals, and active defense is not so necessary. The question of man's place in the system of living things is one of interest, and should be included here. Since man is a mammal and a primate, he has many characteristics of those groups. The primitive property forms, namely, mate, young, home, territory and food, are all his, but are modified somewhat in the exercise of rights over them.

The care of the family is an important factor in the development of human life. Care of the mate varies with different people, and often becomes a cooperative proposition. The young are cared for by both parents, unless death or some other condition leaves them to the care of one parent. The young are fed, tended, guarded, protected, provided with shelter, and trained by the parents, sometimes one and often both.

Human territories are all more or less dependent upon the social group. Thus, the solitary, pair and family territories are all subordinate to the social territory. Solitary territories sometimes exist, but only temporarily; for example, the hermit is solitary, but this condition usually follows over-socialization of the individual concerned. Pair territories usually occur only for a short time prior to the addition of children to a family. This territory then becomes a family territory. The family territory may just include a home, or it may be larger and include a farm or a range area. Group territories exist because of social groupings of various sizes and organization, such as community, county, state, national and international territories. The community may be a city, town, village or perhaps a smaller area. The county, state and national organizations affect areas of various sizes and arrangement, which are controlled in various ways. International territory is not so common as the others mentioned above, but there are international fishing waters which indicate the existence of such group territories.

Food becomes an important attraction and property rights are in evidence. External storage occurs in many ways. Food is stored in refrigerators, cellars, cupboards, granaries, storehouses, elevators. Man also prepares food for storing by means of canning, drying and preserving it. Artificial manufacture of foods, by processing, etc., is quite important with man, and many industries have developed. Scientific agriculture and livestock raising have made it possible to produce bigger and better products. Then, too, food transportation is an outstanding activity which enables a person to obtain a food article, no matter what the season. Hawaiian pineapple, Florida grapefruit, California oranges, Italian olive oil and many other food items foreign to a given area may all be obtained at the same time at the same place, because of our efficient means of food transportation.

Man's greater intelligence, due to his larger cerebrum, has given him the ability to do some things better than other vertebrates, and also has given him certain kinds of property which other animals do not have. His use of fire, clothing, coal, water power and electricity have made man master of the cold and darkness, and his refrigeration is giving him control over excess summer heat. This is distinctive of man, as no other animal has been able to use these factors to its advantage. His greater ability in the use of tools has made him master of his environment. It has made him able to build special shelters and buildings, much larger and more complicated than any other animal can construct, and has developed his power of invention. His greater develop-

ment of agriculture, including storage and diversion of water, has led to ownership of land and domesticated plants and animals. His domestication of plants has insured his food supply, while his domestication of animals has given him mastery over beasts of prey, abundant supply of food and clothing, and a conquest over disease through serums, sanitation and knowledge of nutrition and medicine.

Man has developed a more complex social organization. Besides giving longer and better training to the young, he has developed social regulation of sexual union and social control of companionship. His increased development of articulate speech has helped to bring about his social development, for it has made possible effective communication of new skills and modes of behavior to other members of the social group. It has also made it possible for knowledge and inventions to be passed on to the next generation, which means a storage of ideas. It has been said that plants are chemical-binding organisms, animals are space-binding, and man is time-binding as well as space-binding. Man has gone further than merely passing ideas from generation to generation, for he has developed means and methods of recording events and ideas and preserving the records through writing, printing, drawing and painting. It is, therefore, quite evident that man's property has advanced far beyond food, young, mate, home and territory as they exist in other animals. His rights extend to many forms of private property which he does not occupy nor personally use, except as he receives an income from it, for example, real estate, a mine or an oil well. Man also has social property, such as post offices, churches and roads, controlled and used by the community. Even if man shows advancement in his forms of property, and modifications in the exercise of rights over it, still he, like other animals, uses, enjoys and controls those things which serve to satisfy his fundamental needs.

Due to his greater intelligence, his better articulate speech, and his complex social organization, man has—

1. Made *further* advancement in the control and use of
   a. Tools which have given him greater power to build and construct,
   b. Plants and animals in agriculture and domestic livestock,
   c. Water by greater storage and diversion,
   d. Food by storage and transportation,
   e. Property by legal protection, often divorcing it from personal use and occupation,
   f. Shelter by making better houses and homes.
2. Found and uses new forms of property that other animals have not developed:
   a. Fire,
   b. Clothing,
   c. Coal and oil,
   d. Mines,
   e. Water power,
   f. Electricity,
   g. Factories and other commercial buildings,
   h. Money.
   i. Machinery,
   j. Transportation devices,
   k. Weapons.

Human property rights are indicated by the following attractions:

1. Insurance of fertilization—similar to other mammals, but has more extended courtship and social control of companionship.
2. Care of eggs—all viviparous, therefore no question of property.
3. Family care.
   a. Care of mate.
   b. Care of young.
      (1) Providing shelters.
      (2) Feeding young.
      (3) Tending young.
      (4) Guarding and protecting young.
      (5) Training young.
4. Territory:
   a. Solitary—(subordinate to social).
   b. Pair—(subordinate to social).
   c. Family—(subordinate to social).
      (1) Home,
      (2) Farm,
      (3) Range.
   d. Group territories:
      (1) Community,
      (2) County,
      (3) State,
      (4) National,
      (5) International—(spheres of influence).
5. Food:
   a. External storage—in refrigerators, cellars, cupboards, granaries, warehouses, elevators.
   b. Artificial manufacture—processing, etc.
   c. Scientific agriculture and livestock raising.
   d. Food transportation.
6. Other forms of property previously listed.

SUMMARY

1. Property, in the animal kingdom, means the exclusive or cooperative use, enjoyment and control of those things which are of value, in so far as they serve to satisfy the fundamental needs of the organism. Food, mate, eggs or young, nest or home, territory and in some cases water, are the principal things of value. The development of a desire for these forms eventually brings about the exercise of property rights among animals, which are shown by possession and active defense against aggression and destruction.

2. In fish, external fertilization requires at least an attraction of the male to the eggs or territory. Some fish are attracted to the mate. Some fish build nests and tend eggs; a few protect young after hatching. Certain fish bear living young and a few have brood pouches. Territorial division is not common with fish, but some fish have territory and defend it.

3. In amphibians, fertilization takes place sometimes externally, with male and female in direct contact, and sometimes internally, by the female being attracted to the spermatophores secreted in the water by the male. Usually no care of eggs or young is shown. Exceptions include: (a) care of eggs by amphibians who furnish protection (1) by means of nests or nurseries, (2) by coiling around them, (3) by carrying eggs around with them, and (4) by internal care—ovoviviparous; (b) care of young (1) by tending tadpoles in pits on back, (2) by carrying tadpoles to new pools.

4. In reptiles, internal fertilization with egg laying is the rule, showing more internal care. Most reptiles bury eggs and leave them. Skinks and pythons incubate and defend eggs. Crocodiles and alligators watch eggs and assist young to emerge and occasionally care for young later. Some snakes and lizards bear living young—ovoviviparous. Turtles and lizards show territorial arrangement with food and nesting territories. Turtles and snakes have dens in winter—beginnings of social relations.

5. Birds have internal fertilization and are all egg layers. Mound builders bury eggs and leave them to hatch. Most birds build nests in which they lay their eggs and incubate them. They guard and defend the nest and its contents. Precocial birds guide, guard, protect the young and show them food. Altricial birds guard, protect and feed the young in the nest and many tend the young after they leave the nest. Most birds show some form of territorial claim. Birds show solitary, pair or social territories. Social territories may include family, family flock, intra-specific or inter-specific flock types. The territories may be for the purpose of feeding, nesting or sleeping (roosting). No subdivision is made in social feeding territories, but in social nesting territories each pair has its individual territory within the social group territory. The areas may be (a) day territory, (b) night territory, (c) seasonal, (d) alternate, summer and winter, and (e) permanent territories. They may be divided into horizontal areas or vertical strata. Cooperative defense may occur by (a) mass attack or (b) a closed society. Most migratory birds avoid external food storage problems by storing food internally as fat, but some permanent residents store food externally and sometimes defend their stored food.

6. Mammals with internal fertilization have a few egg-layers, monotremes. All others are viviparous. Parental care is the rule. Mammals as a group show great variation in development from (a) mass storage of food to progressive feeding of embryo, (b) seasonal to continuous sexual attraction, (c) seasonal to non-seasonal production of young, (d) multiple births (litters) to single births, (e) tandem litters to overlapping offspring, (f) seasonal to

long-term parental care, and (g) seasonal to long-term period of maturity. Solitary and pair territories exist for short times, but family and group territories are common. Families are the rule and often groups of families are found with a social organization. Territory may provide food or home. They may be permanent or alternate summer and winter territories. Many mammals store food externally for future needs.

7. Man is a mammal and a primate and has many characteristics of those groups. Care of the family is common. Solitary, pair and family territories occur, but are subordinate to the social group. External food storage is well developed, along with artificial food manufacture, and food transportation. Man, due to his greater intelligence, his better articulate speech, and his complex social organization, has made further advancement in control and use of property used by other animals, and has found and makes use of forms of property that animals have not developed. His ability to use fire, clothing, coal, water power and electricity has made him master over cold and darkness, and his refrigeration is now giving him control of excessive summer heat. His greater ability in the use of tools has given him greater power to build and construct. Greater agricultural development and domestication of plants and animals have given man more property. Man not only passes ideas on to the next generation, but has developed extraprotoplasmic methods of recording ideas which become property and can be preserved and handed on indefinitely. Human property is often divorced from personal use and occupation.

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