May 29, 1962

Mr. Joseph Wales
Department of Fish and Game
Oregon State University
Corvallis, Oregon

Dear Joe:

I read your manuscript and find it most interesting. I'm sure it will be a fine paper and well received. There are a few points I would like your opinion on. You state that cutthroat trout were found throughout the Great Basin during the Pleistocene. Were they also in coastal waters? You write: "By the time this latter species (rainbow) had reached the Columbia River the Snake River Falls had been formed and it could not mix with the 'interior' cutthroat. However, it could mix and hybridize to some small extent with the cutthroat which had reached the coastal streams." To me, this implies that the only coastal cutthroats at that time were those which escaped from the Great Basin. Do you believe that the cutthroat progenitor came to North America, entered the Great Basin where it evolved into the interior cutthroat but left no remnant populations in coastal waters? Where do you think the cutthroat progenitor came from? If we trace the Salmo line, I find the most primitive Salmo-like fish to be Salmothymus ohridanus known only from Lake Ohrid, Yugoslavia. The cutthroat, by retaining basibranchial teeth shows affinities to the ancestral form but the high number of vertebrae and scales of our present day cutthroat leaves a gap filled by no known living or fossil form. The only clue to a relict intermediate is a specimen at Stanford University listed as a paratype of Salmo formosanus from Formosa. This specimen has basibranchial teeth and is coarse scaled. Last year I received five specimens from Formosa but none had basibranchial teeth and only represent an undescribed subspecies of Oncorhynchus mason. I have a paper in press on this now. I am including a reprint of my original findings on the Stanford specimen.

Concerning your theme on the effects of natural hybridization on rainbow and cutthroats I believe that the effects of hybridization is evident on certain rainbow populations in the Frazer, Columbia, and Upper Sacramento systems. Here we find rainbow populations with high scale counts, unusual color and spotting patterns and sometimes a cutthroat mark. These drainage basins all border on areas where interior cutthroat may have been naturally transferred

with subsequent hybridization. In smaller coastal streams the resident rainbow and cutthroat appear to be quite typical of their anadromous brethren with no evidence that hybridization has influenced them in any way.

I have a copy of the California Fish and Game report on golden trout. I was hoping that the Department would make a firmer statement on what a golden trout is. I can definitely state that the golden is not merely a highly colored rainbow. The true golden trout of the South Fork of the Kern and of Golden Trout Creek is so distinct that anyone with a modicum of taxonomic training could evaluate the situation in the Sierras today as to the relative degree of pureness of the various populations. I would also like to see rainbow, cutthroat, and golden trout hybridized to check relative fertility.

What do you know about the trout of the upper Klamath Lake drainage? The literature is confusing, but evidently both rainbows and cutthroats were native. According to C. H. Gilbert, the rainbow was the typical coastal type. I suspect that the endemic cutthroat of this region was an interior type. I know of none in any collection and I wonder if any pure strain may still exist.

Do you have an opinion on the royal silver trout, Salmo regalis, of Lake Tahoe? This is a real puzzler. It was described many years after rainbow-cutthroat hybrids were stocked in Lake Tahoe. Three of the four type specimens have basibranchial teeth, suggesting a hybrid origin. Two recent specimens have smooth basibranchials and typical rainbow scale counts. There are some characters such as the morphology of the adipose fin and fin ray counts which indicates that regalis was and still is a distinct entity.

Many thanks for the advanced copy of your abstract and for any comments you may care to make on the above mentioned points.

Very truly yours,

Robert J. Behnke
Research Assistant

RJB:fbc

cc Dr. P. R. Needham

June 27, 1962

Mr. Joseph H. Wales
Department of Fish and
Game Management
Oregon State University
Corvallis, Oregon

Dear Joe:

Many thanks for providing Bob Behnke and me an opportunity to review your manuscript. There is much stimulating material here, especially on the geological influence of trout distribution. Is this paper for publication or for presentation at the AIBS meetings? If it is for publication you may want the complete citation of Nikolsky's work. Transliterated it would be: Ryby Basiena Amura, published by the Academy of Science U.S.S.R., Moscow, ~~1961~~ 1956, 551 pp.

You have devoted some discussion on rainbow-cutthroat hybrids so you may be interested in what is probably the only detailed scientific data on the subject, done by Hartman (1956. A taxonomic study of cutthroat trout, Salmo clarki clarki Richardson, rainbow trout, Salmo gairdneri Richardson and reciprocal hybrids. M.A. thesis, Univ. Brit. Col., 71 pp.). Hartman used hatchery stock. His rainbows were derived from Kamloops rainbow and the cutthroats originally from Chilliwack Lake, probably represented the resident coastal form. The following data show some results:

Parents male	Parents female	Viability % hatch	Number of Basibranchial Teeth at 2 years of age present	absent
R	R	71.5	0	4
C	R	78.0	2	6
R	C	14.6	6	9
C	C	13.9	14	0

There was no significant difference in the sex ratio of the hybrids. You may note that although the female cutthroat was probably spawned too early and the eggs lacked viability, the hybrids produced a higher percentage of hatching in both crosses. This study was to continue and we all will have to inquire with Dr. Lindsey on the subsequent results. From our experience with hybrids, the following points are evident: In interior waters where only cutthroat were natives, no barriers to hybridization were built up and when rainbows were introduced, the gene pools were so rapidly altered that it often seems like the hybrids actually had a selective advantage. Only where the native cutthroat was highly adapted for a particular environment such as the lacustrine adapted Lahontan cutthroat in Lake Tahoe and Pyramid Lake and Independence Lake were they able to resist hybridization against massive introductions of rainbows. In coastal waters there is some evidence of hybridization, but the samples we have investigated are quite different from interior hybrid samples in that the hybrid specimens are few in number and the parental forms are recognized. In other words, if we plot the data we get two or three modalities in coastal hybrid situations whereas in interior waters there is a great, but continuous variability. This suggests that in coastal waters the trout niche is so divided by the rainbows and cutthroats that the hybrids are at a selective disadvantage.

Salmo clarki alpestris (an interior cutthroat that was considered synonymous with S. c. lewisi by Qadri, Jour. Fish. Res. Bd. Can., 16(6)) occurs in some Fraser River tributaries, but its presence there is almost certainly due to headwater stream transfer from the Kootenay area of the upper Columbia system. At least this is the opinion of Dr. Lindsey and it does seem more logical than to consider them as relict Fraser River cutthroat.

We have an article which should appear soon in the Progressive Fish Culturist; it is entitled, "The origin of hatchery rainbow trout." We based our opinions on your 1939 McCloud River Report, the writings of Livingston Stone, and from the examination of specimens. We concluded that the original hatchery rainbow represented a mixture of the coarse scaled steelhead and a fine scaled resident rainbow. The species named stonei and shasta both represented the fine scaled resident form. The

fine scaled rainbow of the upper Sacramento system had its origin from an invasion of interior cutthroats mixing with the native rainbow. This should agree nicely with your own views.

You consider four genetic complexes of western North American Salmo. While we don't basically disagree with you on this point, we would place our emphasis somewhat differently. The coastal rainbow has both resident and anadromous populations throughout its range. They are quite homogeneous and we consider them all as Salmo gairdneri. In the Fraser, upper and middle Columbia, and the Sacramento systems there are fine scaled rainbows with a strong indication of cutthroat influence. The coastal cutthroat, like the coastal rainbow, has sea-run and resident populations - all are considered as Salmo clarki clarki. There are some cutthroats from tiny streams above barrier falls which are coarse scaled, like a typical rainbow, but we believe this is a local adaptation and not indicative of rainbow influence. The interior cutthroat presents some problems. Except for henshawi and stomias, most of the rest may be considered in the highly variable subspecies of lewisi. The fact remains that in Twin Lakes, Colorado, populations of stomias and what was called macdonaldi, once were differentiated enough to live sympatrically as two good species. The golden trout is the most difficult to explain. The key seems to be a hybridization between primitive rainbows and cutthroats in the lower Colorado River and long isolation. There are four known (Gila, Kern, Mexican goldens, and Arizona goldens) populations which may be considered belonging to the golden trout complex. We take it that for the time being you are considering golden trout as rainbow offshoots and so are included as one of your major genetic complexes.

Your paper has much good material, Joe, and we enjoyed reading it. Let us know where and when it will be published.

Sincerely,

Paul R. Needham
Professor of Zoology-Fisheries

PRN:fbc

Enclosures

Airmail

cc Mr. R. J. Behnke

Rainbow and Cutthroat Trout - A Zoogeographical Study

Joseph H. Wales

The climate of the area which we now call the Great Basin was not suitable for the trout genus, Salmo, until the middle or late Pliocene. At that time, according to King (1958), "The summit level of the central and northern Sierra Nevada must have stood at an altitude of less than 3,000 feet, and projected about 1,000 feet above the Great Basin to the east, it created no more than an ineffective rain shadow over that area. Evidence of fossil fishes suggest that the Great Basin at this time stood at altitudes well below 2,000 feet, to allow the engress of lowland coastal faunas." It seems likely that Salmo first entered the faunal picture of western North America prior to the Sierran uplift of the Pliocene. Hubbs and Miller (1948) state the case clearly when they say, "In the present stage of knowledge it would verge on fiction to attempt to hypothesize in any detail the pre-Pleistocene history of the faunas of the Great Basin. Alternating periods of floods and desiccation, of lava flows and stream capture, of mountain building and planation, of speciation and extinction, must all have modified the distribution of life, in ways that we cannot now analyze in any detail or with any assurance." It also is impossible to make any intelligent guesses about the place of origin of Salmo clarki, the cutthroat trout, or its immediate progenitors, or its route to western North America. The problem with which this paper is concerned

is the distribution and the interaction of Salmo clarki and Salmo gairdneri during the Pleistocene and Recent epochs so we will begin at the time when S. clarki is established in the Great Basin area of western North America. If clarki approached the continent from the ~~continent-ocean~~ Pacific coast it probably left no representative populations in the coastal streams. The tectonic changes which took place in the coast ranges of the continent during the late Pliocene and the Pleistocene were great, and although these do not preclude the existance of trout populations we have no evidence that these fish withstood the radical changes of the period. In western North America, during the great extent of time of concern to us, periods of drought and moisture alternated as the glaciers advanced and receded. The most prominent water masses were LakesBBonneville and Lahontan but hundreds of smaller lakes and probably thousands of miles of stream formed an aqueous network throughout the Great Basin and into the mountains bordering it. It may be assumed that one of the dominant fishes of this water system was the cutthroat trout. Over this very long period of time the major and the minor climatic fluctuations integrated and disintegrated the water systems of the basin. As a result the cutthroat population presumably was broken into a great many subpopulations isolated in more or less different aquatic environments. Some of these were isolated for hundreds of years, some for thousands, and the result was a medley of more or less distinct taxonomic forms. It may be assumed that such taxa were often reunited by climatic changes, only to be fragmented as periods of moisture slowly turned to drought. By the time white man entered the picture the species had declined in abundance until it was little more than a few relict populations widely scattered over the area shown in Fig. 1. The major population actually was no longer in the Great Basin but was in the upper Snake River drainage and some of

the Missouri River tributaries. Lake Bonneville had overflowed into the Snake River at a point near Marsh Creek during the peak of the Fluvial period, approximately 25,000 years B.P. (Stearns, Crandall and Steward, 1938). Whether this was prior to or following the formation of the great falls of the Snake is immaterial in this connection but it was probably considerably before the volcanic activity altered much of the Snake River plains area and produced the several falls. The trout moved both up and down the Snake River. Those which went downstream followed various paths. Some ended up in the ocean and from there worked north and south into all the coastal streams from the Aleutian peninsula south possibly into the Gulf of California. Others penetrated all of the tributaries of the Columbia River, some attaining the Height of Land which separates the Fraser from the Athabasca drainages, but none were able to cross this divide (Lindsey, 1956).

At this point in the late Fluvial the cutthroat were widely distributed in nearly all the streams from the Rockies to the Pacific and from Alaska to Northern Mexico. Presumably most of the large lakes of the interior drainage contained them but there is no evidence that many lakes of the coastal area became populated. The number of subspecific taxa which may have developed in this broad range could have been quite large but the species did not break up into anything which this writer believes should be called a separate species.

Let us now leave the cutthroat and consider the rainbow trout, Salmo gairdneri. The point of origin of this species is not as easily traced as the cutthroat. Very little serious thought has been given the matter, but perhaps the best comments on the problem are those of Neave (1958). He points out the very close relationship of Oncorhynchus and and Salmo gairdneri in anatomical and behavioral characters. This has

been noted by many other students of these salmonids. Neave, however, has proposed that Oncorhynchus could have broken away from a Salmo stock, " — not later than the early Pleistocene." He also proposes that the Sea of Japan could have been the area in which this division took place. Neave has used conclusions of Lindberg (1937 , 1953) which indicate at least three periods, one prior to the Pleistocene and two during the Pleistocene, when the Asiatic coastal region of the North Pacific rose enough to form enclosed basins. It is presumed that the resulting environmental changes would stimulate the evolution of new species. It is entirely possible that Salmo gairdneri originated in one of these basins during one of these periods. R.J. Behnke (personal communication) has summed up the available information on Salmo mykiss and S. penshinensis. He has also examined specimens of both species in Leningrad. His conclusion is that S. mykiss is the same or only subspecifically different from our west coast rainbow (non-migratory S. gairdneri) and that S. penshinensis is the same or only slightly different from our west coast steelhead (migratory S. gairdneri). These forms have been long known from the Kamchatka peninsula and Mikhalsky (1959. Fishes of the Amur Basin) records S. penshinensis from the Amur River. Apparently no one has tried to explain the absence of mykiss from waters south of the Amur. The rainbow introduced into Japan from California have been successful. Why did mykiss fail to become established? During much of the Pleistocene and the Recent it was too cold for gairdneri (mykiss) to extend its range eastward to the west coast of North America but during the Hypsithermal period, which probably extended from 6,000 to 4,000 years B.P., the climate would have been suitable for the eastward penetration of Salmo.

Walters (1955) states that the Bering Land Bridge was destroyed, " — more than 11,000 years ago." This bridge with its streams in which Salmo could have spawned may not have been necessary for the movement of Salmo from the Asiatic to the Alaskan coast but there appears to have been a period during the existance of the bridge when temperatures and the absence of ice would have permitted Salmo to move short distances from stream to stream in an eastward direction. "The mild Alaskan climate of 13,600 years ago either occurred when the land bridge was in its final stages or after it had been drowned." (Walters, 1955). Assuming that the behavioral pattern of Salmo gairdneri (mykiss, penchinensis) was essentially the same 10,000 years ago as it is now we can say that it is probable these fish moved eastward by straying from one spawning stream to the next across the land bridge while these streams were both flowing and warm enough to permit development of eggs and young. This mode of distribution would not be absolutely necessary since we can probably assume that straying from streams of the Kamchatka area to north-western Alaska could have occurred in one great leap during the several thousands of years between the time we assume it originated on the Asiatic coast and the Late Pleistocene or Recent when it may have reached North America.

The evidence supporting this mode of distribution of the trout we call Salmo gairdneri has been obtained through the elimination of alternative modes. The native distribution of this species is confined to the west coast of North America and to the Kamchatka area and Amur drainage. At only one point has it gotten out of the Pacific coastal waters. This is in the Athabasca drainage. Since it has been introduced by man into much of North America it has become established in a great many places. The only possible explanation for its absence from the central and eastern portions of Canada and the United States is lack of time for the

Eagle L. Trout
a royal salmon
trout of Tahoe

usual means of distribution. If it had been present in the coastal streams during the Pluvial period it is probable that it would have been able to penetrate further inland than it has. If the species had come to the west coast from any point in the eastern half of the continent it would have left more or less extensive populations in the waters suitable for it. The rainbow is probably the most adaptable of all salmonids and man has found no difficulty in getting it established in many waters in nearly all the northern tier of states and the southern tier of provinces from the Pacific to the Atlantic. Despite the great many severe climatic changes which have occurred in North America these could not have exterminated all the populations east of its present native range. Rainbow cannot establish themselves in waters north of their present limit, at least during the present climate. During the Hypsithermal period it might have been possible for rainbow to have extended their range north into the Artic Sea. It could be argued that during this warm period rainbow came west through the Artic Sea from the Atlantic. Whether this would have been physically possible is unimportant to this particular study. If rainbow (steelhead) had made such an extension of range they would have left populations scattered through the drainages of the Artic Ocean, Hudson Bay, or along the Atlantic coast in the same or similar waters to those in which we found S. salar. The fact that no rainbow or steelhead or any other Salmo more closely related than clarki occurred anywhere on the continent other than in those waters already mentioned seems to be conclusive proof that they did not reach the west coast by any "overland" route or via the Artic Ocean. If they did not come from the Asiatic side of the North Pacific then they must have developed someplace along the North American Pacific coast. The historical geography of this coastal area indicates no reasonable site of evolution of a species such as S. gairdneri. There seems to have been no enclosed

areas in which the changes in the aquatic environment could have developed a new species and held it free from outside genetic "contamination" during the time required to permit fixation of characters before being released. In other words there seems to have been no places on the western coast of North America similar in function to the Bering, Okhotsk, or Japanese seas. It is the inevitable conclusion that S. gairdneri reached its specific stature while isolated in one of the seas noted above. At the end of one of the Pleistocene glacial epochs it was released by the rising level of the North Pacific and upon release gradually extended its range eastward across the Bering land bridge or in one great step to northwestern Alaska. At such a time the great glacial mass had receded from the Alaskan and British Columbian coast and gairdneri could work its way far to the south.

Eventually this species reached the Columbia River and penetrated this system as thoroughly as possible. We are particularly interested in its distribution in the Snake River. At some time in the late Pleistocene and Recent epochs many volcanic eruptions occurred in the upper half of the Snake drainage. These continued to occur over a long period of time and as the lava spread out it had a profound effect upon the course of the Snake and its tributaries. (Stearns, Crandall and Steward, 1938). Unfortunately the dating of these flows is difficult. It has been shown by several writers that the Snake River course was greatly altered from time to time. Lakes would be impounded by the flows and eventually break out and cut new channels. The important part of this process is the formation of high falls which very effectively prevented the upstream movement of fish. Both salmon and steelhead (S. gairdneri) were unable to ascend some of these falls. In particular the Shoshone Falls which are situated near the present city of Twin Falls,

Idaho were the upstream limit of the distribution of these fish at the time white man reached the area. None of the S. gairdneri complex occurred in the Snake River drainage until they had been transplanted by man. There are two schools of thought, one is that the steelhead did get into the upper Snake before the falls were formed and that volcanic activity exterminated them (Hubbs and Miller, 1948), and the other explanation is that they did not reach the area until the falls had developed. Those who believe that the gairdneri were exterminated think that they were in the upper Snake before Lake Bonneville overflowed into the Snake, that, " — the fauna of the upper river came to some cataclysmic destruction during or after the formation of the falls and prior to th Bonneville overflow." (Hubbs and Miller, 1948). The writer believes this is unlikely for several reasons. Russell, (1902), Stearns, et al,(1938) have given evidence of extensive volcanic activity in the Snake River plains area, and it is not impossible that such lava flows exterminated the river fauna for relatively short periods. However, these flows did not effect the many tributaries to the same extent. Hubbs and Miller (1948) support this, "In agreement with the geological evidence that some of the cold upper tributaries of the Snake lay above the lava flows and hence escaped destruction, there occur in the upper Snake certain headwater types (three suckers, Catostomus catostomus pocatello, Catostomus syncheilus and Pantosteus jordani, and one sculpin, Cottus bairdii tubulatus) that also inhabit other parts of the Columbia River system but are absent from the Bonneville basin proper." If these species persisted in the headwaters through the period of destruction in the main river it is very difficult to see why the trout would not have done likewise. It has been shown in many places in the west coast streams that gairdneri occurs much closer to the source of tributary

waters than do the suckers and sculpins. Rainbow were able to penetrate to the headwater tributaries of the Fraser and worked their way on over the continental divide into the Peace and Athabasca. Hubbs and Miller (1948) also point out that, "The isolated fauna of the Lost River group of streams seems to represent a partial relict of the upper Snake fauna as it existed prior to the lava flows." These writers found, — an endemic subspecies of cutthroat trout, the Dolly Varden trout (probably a glacial relict, rather than an introduced fish), and 5 highly localized, endemic subspecies or races in the genus Cottus. — As mentioned on page 31 these fishes seem to be relicts of the old Snake River fauna, as it existed prior to the time of the destructive lava flows and of the Lake Bonneville discharge." There is every reason to believe that if these species persisted throughout the destructive lava flows in the plains area that gairdneri would have persisted also. Trout of the gairdneri complex are among the more adaptable of the west coast fishes. In a great many headwater streams of Pacific coast drainages the rainbow is the only fish which has been able to withstand environmental stresses. The assumption that all of the gairdneri could have been exterminated from the headwater tributaries of the upper Snake River and from the Lost River system without also destroying the suckers and sculpins, the cutthroat and the Dolly Varden is very difficult to accept. All of the evidence supports the theory that gairdneri did not reach the Snake River until impassable falls had been formed. Presumably that this was the case it means, obviously, that the steelhead could not reach the cutthroat populations isolated above the falls, in the Snake drainage, in the Missouri headwaters, and in the Great Basin generally. As a result we find that prior to man's intervention there were two groups of cutthroat, one which had been penetrated by gairdneri and one

which had not. The effect of these two species upon one another has not been thoroughly considered. Many biologists have mentioned the extent of hybridization and the appearance of the hybrids. Fishculturists have repeatedly crossed the two intentionally and unintentionally and have noted the fertility of the eggs and viability of the young, however, no really definitive study has been made. The situation in Bear Lake, Utah-Idaho, as described by McConnell, Clark and Sigler (1957) seems pertinent. "The Utah cutthroat trout is the only trout native to Bear Lake. Early introductions included Yellowstone cutthroat trout, probably other subspecies of cutthroat, and rainbow trout. Two circumstances - the stocking of mixed species of Salmo and the fact that all species of spring - spawning Salmo apparently hybridize freely in Bear Lake - have produced today's Bear Lake cutthroat trout. —— The dominant cutthroat trout type is the hybrid described above. —— At one time during the study, an attempt was made to determine the degree of hybridization between cutthroat trout and rainbow trout. However, this attempt was abandoned as being impractical, if not impossible, and all fish that had been labeled as either cutthroat trout or cutthroat x rainbow trout are designated in this study as cutthroat trout." These writers also comment on the situation in the Logan River. "The status of cutthroat trout in Logan River is not greatly different from that of the cutthroat in Bear Lake. In Logan River, the Utah cutthroat trout has been replaced by a mixture much like that in Bear Lake; —" Simpson (1949) in describing the cutthroat trout in Idaho says, "The cutthroat and rainbow trout will cross readily with the resulting fish having low reproductive capacity but with a hybrid vigor. Generally the trout which are crosses between a rainbow and a cutthroat will grow larger and much faster." This reduction in "reproductive capacity" may be generally true or it may only apply to the hybrids of certain subspecies.

Stefanich (1951) reporting a study of Prickley Pear Creek, Montana, a tributary of the Missouri River, said, "Some hybrid rainbow x cutthroat trout were present but were so difficult to distinguish from the rainbow trout that it was not practical to separate them." Weisel (Date ?) in discussing the cutthroat of intermountain Montana says, "Introduced rainbow trout have also crossed with the cutthroat. The result is a hodge - podge." — " Cutthroat trout are on the way out. Rainbow trout, brown trout and brook trout are taking over more and more of their haunts. Only in a few isolated lakes, in streams above obstructing log jams, and in streams of primitive areas are they to be found in numbers and untouched by hybridisation. Every effort should be made to preserve this native. Besides their ability to fight, their meat is considered by many to be the most delectable of all trout. —— In western Montana rainbow are not taken as frequently from small headwater streams as cutthroat are, but are widespread in most of the lakes and larger streams. In some localities they have become inextricably mixed with the cutthroat." Miller and Alcorn (1943) in discussing the several species and subspecies of trout in Nevada have this to say, " The existance in Nevada today of pure strains of th Lahontan cutthroat trout is uncommon or rare because of the hybridisation between Salmo clarkii lewisi and Salmo clarkii henshawi and the artificial and natural crossing of cutthroat and rainbow trout. For this reason it is extremely difficult to identify with certainty the subspecies of Salmo clarkii now present in Nevada." Miller (1950) makes a most important suggestion in the following paragraph, "Intraspecific interbreeding resulting from indescriminate stocking has probably altered most of the many local subspecies and races to so great an extent that their original characteristics are difficult or impossible to determine.

In addition, the rainbow trout has hybridized extensively with the native cutthroat trouts (subspecies of S. clarkii), where it has been introduced into intermountain and Rocky Mountain waters formerly inhabited only by cutthroat. Where cutthroat and rainbow naturally coexist, in coastal waters from northern California northward to Alaska, they evidently do not hybridize or do so only rarely. The close approach between coastal cutthroat and rainbows in a number of characters may indicate, however, that hybridization has taken place, perhaps in the Pleistocene epoch." [1]

The foregoing comments on hybridization of rainbow and the interior cutthroat clearly indicate that prior to the advent of white man these two species had not come together. The situation with respect to the coastal cutthroat and the rainbow is quite different. In the first place it is not always a simple matter to distinguish the two, especially the juviniles. Considerable variation exists in the morphological characters used to separate the two and it is quite difficult to identify hybrids. Vernon and McLynn (1957) pointed out that, "The identification of the sea-run variety of Salmo gairdneri (steelhead) and the coastal cutthroat Salmo clarki clarki can be difficult, especially when the two species occur together. In older fish hyoid teeth, mouth size, and colour characteristics readily separate the species, however, these characteristics are not sufficiently developed in the younger and smaller fish to be useful for purposes of identification." They carefully analyzed the differences in the scale characteristics of the two species in the yearling

[1] The underlined sentence is particularly noteworthy.

age group and have shown these to be helpful in identification. DeWitt (1954) states that, "There was great variation in coloration and an even greater variation in spotting. It was impossible to select any one specimen as a truly "typical" coastal cutthroat which would represent all others in its general appearance." As Miller (1950) has pointed out there is no single character which can be used invariably to distinguish all cutthroat from all rainbow, however, there has not been a serious effort on the part of anyone to lump them into a single species. The following comment of DeWitt (1954) is important, "Fish taken in or near tidewater areas were the most uniform in appearance. The most marked diversity occurred among those in small streams and in headwater areas." The writer believes that the marked degree of overlap in most characters of gairdneri and clarki (coastal) and the apparent absence of any character which never overlaps is an indication of hybrid origin. Apparently, however, not all populations of coastal cutthroat contain within their gene pools the same amount of rainbow genetic material. To express it in another way, if the coastal cutthroat has been derived by hybridization of the interior cutthroat and gairdneri it appears that not all populations contain the same admixture of gairdneri genes. In the coastal streams inhabited by cutthroat the general behavior is a migratory one, but in the more distant, headwater tributaries it appears that these trout tend to be less migratory. The best evidence of this comes from our knowledge of populations isolated above impassable falls. There are many such cases throughout the coastal cutthroat range. Obviously such streams have contained cutthroat for long periods and falls have been formed at points where exposed bedrock has caused irregularities in normal erosion rates. Eventually such falls may become impassable to either sea-run gairdneri or sea-run clarki. At least a part of the native trout population remained in the stream section above the falls and have tended through inbreeding to fix

characters of both a behavioral and a morphological nature. Carl and Clemens (1948) in a discussion of S. clarki alpestris Dymond, who described this form of cut-throat trout (1931), points out that this fish occurs in the central area of the Province where the Kamloops is the common trout, but the cut-throats are found only in a few isolated localities, usually in headwaters of mountain streams where they are cut off by impassable falls. Some are also found in streams which do not contain insurmountable falls, which suggests that these particular localities are more suited for the cut-throat than for the Kamloops." The Kamloops (S. gairdneri kamloops Jordan) fills an ecological niche occupied by the non-migratory rainbow further south. Needham and Gard (1959) have added information from various sources to the small body of knowledge regarding artificial hybridization. The attempts which have been made to cross these species are few and several subspecies have been used. It can be seen that the fertility of the eggs is sometimes poor and that the survival of the embryos was in some cases low but the vitality and the appearance of the survivors is reported to be entirely satisfactory. These authors report artificial crosses performed by G.C. Webb, former Superintendant of the Alsea River hatchery, Alsea, Oregon. The coastal cutthroat and steelhead were used and a rather large number of offspring were obtained. These tended to differ from the parents but apparently the important morphological characters were not analysed. Prof. R.E. Dimick (unpublished data) reported a cross between a coastal cutthroat and a steelhead in which 16 of the F_1 generation were examined and none had basibranchial teeth. In the F_2 two of the 20 fish examined had these teeth. F.H. Sumner (1961, personal communication) indicated that observations over a period of several years on the coastal cutthroat in northern Oregon streams support the belief that steelhead do not hybridize freely with the cutthroat or at least such crosses result in very few recognizable hybrids. It is quite obvious that if hybridizing

F2 generation of hybrids

of these sympatric species was a common thing and that fertile offspring were common then in a very short time the identity of the parent species would dissappear. This point will be discussed later.

Although hybridization of gairdneri and clarki in the smaller coastal streams or the lower portions of the larger streams seems to be infrequent or at least unimportant the situation in the headwaters of the coastal streams may be somewhat different. To understand this we must realize that in the coastal streams of the west coast there are migratory gairdneri and migratory clarki and there are non-migratory gairdneri and non-migratory clarki. The evidence for this is so abundant that supporting references may be superfluous. Many studies have been made which clearly indicate the presence of migratory populations of both species but the reality of non-migratory populations in many of these same streams is less easily verified, except in those streams which have impassable falls. In such cases either cutthroat or rainbow can be found above the falls and the mere fact that these fish have remained isolated from the sea or from larger streams below is sufficient proof that non-migratory groups of both species do exist. It is not assumed that fish isolated above falls are the only ones which do not migrate. Neave (1944) proved the existance of both migratory and non-migratory gairdneri in the Cowichan River on Vancouver Island, British Columbia. Numerous observations of the writer and others indicate clearly that similar dichotomy exists in the gairdneri of the Klamath River of northern California. It cannot be supported by experimental evidence but the writer believes it is safe to assume that non-migratory populations of either or both species occur in a large part of all coastal streams. The importance of this situation to the present study is that in the small headwater tributaries hybridization and inbreeding will lead to the development of unique populations. Several ichthyologists have noted the presence of small populations of trout in headwater

streams (and lakes) which display a mixture of gairdneri and clarki characters. These characters are usually in coloration, red slash on the hyoid membrane and spotting, the length of the head and maxillary, the shape of the body, number of scales and presence or absence of basi-branchial teeth. Dymond (1932), as already pointed out, described a form of clarki from headwater streams and lakes in central British Columbia. He also described a form of gairdneri from some small lakes in the Selkirk mountains of British Columbia. This fish seems to display a coloration much like that of some populations in headwater streams of the Pit and McCloud Rivers of northern California. In these latter groups of fishes, although there is much variation, there is a hyoid slash, some yellow on the abdomen, and spotting more like that of cutthroat than of gairdneri. Perhaps the most noteworthy population of gairdneri which displayed the red hyoid slash of the cutthroat is the former McCloud River, non-migratory rainbow of northern California. Jordan (1894) in his description of S. gairdneri shasta notes that it had, " — usually a trace at least of orange dashes between branches of lower jaw." He also gave the scale count as, "Scales intermediate in size between those of the Coast Range trout (Salmo gairdneri iridiens) and those of the Cut-throat trout; the usual number of transverse series about 145." The writer would like to call attention to the fact that this was the population of fish from which eggs were taken and shipped throughout the northern hemisphere. It appears, therefore, that a large part of the domesticated "rainbow" of the world, and the fish from such stocks, contain some cutthroat heritage.

In other isolated headwater streams of California which are outside the cutthroat range the fish are often completely without cutthroat characters so the mere isolation of gairdneri in such stream environments does not mean that cutthroat-like gairdneri will develop. This

has led the writer to conclude that west coast streams within the coastal cutthroat range more commonly have non-migratory cutthroat in the extreme headwaters, and that these fish seem to display some characteristic gairdneri features. On the other hand non-migratory populations of gairdneri in the headwaters of streams outside the cutthroat's present range may display some of the unique characteristics of cutthroat. Such streams are presumed to have had runs of migratory cutthroat in a relatively recent geologic period. Obviously this whole problem lacks the supporting evidence which it should have, but it seems clear to the writer that within the west coast of North America between the Kuskowim River of northwestern Alaska and northern Mexico there are four genetic complexes. These are the migratory steelhead (S. gairdneri) and the migratory cutthroat (S. clarki) and the scattered populations of gairdneri (usually non-migratory) which have evidence of cutthroat ancestry, and the reverse of this, or scattered (usually non-migratory) populations of clarki which have evidences of rainbow (steelhead) ancestry. It should also be repeated that within the S. clarki complex there are two main subdivisions, the "interior" and the "coastal". The writer wishes to emphasize his belief that the "interior" cutthroat complex had never been invaded genetically by the gairdneri complex. The populations of interior cutthroat unmixed with gairdneri are now very few, and steadily growing fewer. The writer also wishes to repeat his firm belief that the entire coastal cutthroat complex has been invaded to some extent by the steelhead (S. gairdneri). When clarki first escaped from Lake Bonneville and move down the Columbia River to the sea it was the only Salmo on the west coast of North America. Presumably it penetrated all of the coastal streams from northern Alaska to Mexico. Sometime later S. gairdneri moved into this area from the north-

eastern Pacific and began to hybridize with the cutthroat. Phenotypically at least the migratory gairdneri (steelhead) seems to show little evidence of genetic mixture with the cutthroat. If we assume that gairdneri and mykiss (penshinensis) were originally the same then the extent of difference between the steelhead of the west coast streams of North America and the migratory penshinensis of Kamchatka would be the result of the genetic infusion from clarki. This point must be resolved by considerably more work. Of great zoogeographic interest is the presence of species of trout above impassable falls. Through the mutual assistance of ichthyologist and geologist the distribution of the fish can be dated from the known age of the falls and the age of the falls can be dated if the distribution of the trout could be more accurately timed. Falls are rather common in these coastal streams and we may safely assume that they have been forming continuously since the early Pleistocene. We may also assume that the cutthroat reached these streams before some of these falls had been formed. Theoretically the interior cutthroat might have become isolated by falls formation in some streams before gairdneri entered the scene; others have been isolated after hybridization with gairdneri. If enough comparisons of these isolated populations, one with another and with uniselated populations below the falls, some interesting conclusions might be reached. The age of some of these falls might be obtained by geologists. The unfortunate part of the problem is that man has scattered trout throughout the suitable waters of the continent and few "original" populations of trout still remain above or below any falls. However, there are some truly native populations left and could form the basis of a very important study.

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THE

Izaak Walton

MAGAZINE

Outdoor America

Official Publication of The
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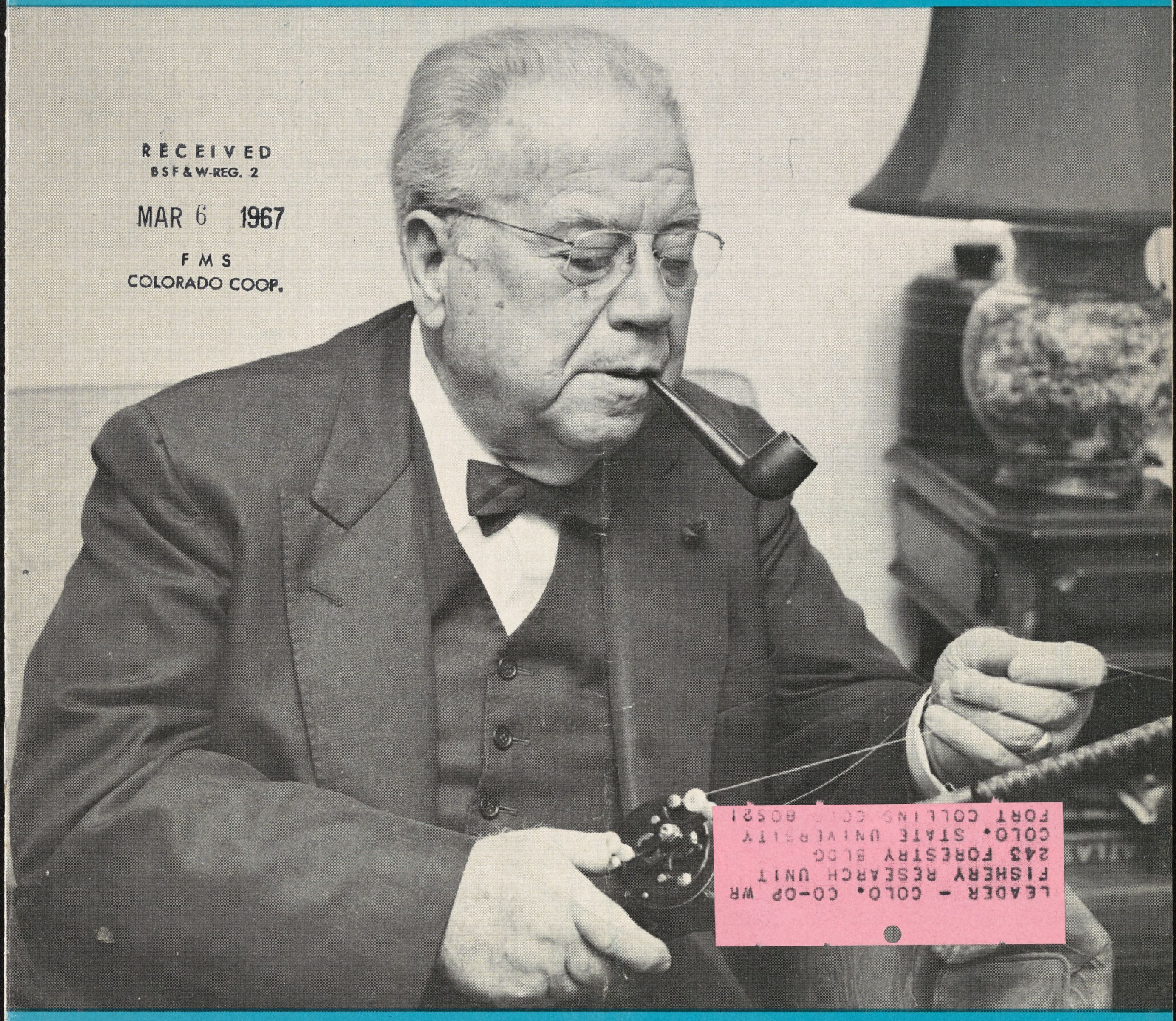

Dr. Preston Bradley — "The Pleasant Heretic" — "Izaak Walton League Founder." See pages 10–11.

A Fisherman's Organization?

At rather frequent intervals some perturbed Waltonians bring up the question of the League's public image. They say the general public has the idea we are just a fisherman's organization.

Even if we were, just a fisherman's organization—is that bad?

There is very good evidence that the founders of the Izaak Walton League were primarily fishermen and, therefore, primarily interested in doing something specifically for the fishermen of America. However, there is just as substantial evidence that these far-sighted men soon found out that the interests of fishermen called for activities along a greatly expanded front.

In order to have good fishing they found that pollution had to be stopped. A whole host of other urgencies that had more or less direct bearing on fishing soon became evident. A great many of these problems affected hunting as well as fishing. Affected bird watching, swimming, picnicking, even water skiing. The protection of wilderness, development of research in all phases of wildlife management, proper use of a frightening array of pesticides, even the effort to land a man on the moon had an effect directly bearing on the fisherman. Of course there is always the danger that any organization is liable to spread itself too thin. There will always be those who demand more attention be given to their own specific interest. Others will insist that the League's program be concentrated on one phase with all others excluded.

This question of hewing-to-the-line is not limited to The Izaak Walton League. At the last count there were 123 national organizations listed in The National Wildlife Federation's directory of organizations concerned with Natural Resource use and management. This is over and above the International, National and Regional agencies and commissions. In addition, there are numerous governmental agencies which frequently complain that other governmental agencies are competing with or overlapping their particular spheres of activity. Any attempt to analyze the specific field of activity of any single one of these voluntary or governmental agencies leads into a morass of confusion and doubt. It may well be found that all have expanded or are in the process of expanding their programs in an attempt to cover the complex and extensive field of resource use and management.

After some 45 years of intensive attention to the pollution problems of America, the Izaak Walton League finds a comparatively sudden interest and action by many organizations and agencies and certainly welcomes this nation-wide support of such a vital problem.

If the Izaak Walton League is a fisherman's organization and, in the interest of preserving fishing, has had a strong hand in cleaning up pollution in American waters, we say—so be it.—**R. B. Mc.**

Milwaukee, (Wis.) Offers a combined husband and wife membership, $10.00 for the husband alone, $15.00 for husband and wife—*East Fork, (Iowa)* enters winning float in Algona Community parade displaying Izaak Walton League objectives—*Johnson County, (Iowa),* celebrated paying off mortgage on chapter property by burning mortgage with help of State officers—Lorain County, (Ohio) asks voluntary donations from members for upkeep of chapters 100 acre property so a few members will not have to labor putting on clam bakes, turkey shoots, raffles and fish dinners for funds—*Portland, (Oreg.)* expects fine results from special State Legislature Committee on air and water pollution made up of individuals appointed because of abilities rather *than political prestige—Old Dominion, (Va.)* asks help in securing attendance at chapter meetings *Ed.* note: this is an almost universal complaint)—*Ottumwa (Iowa)* is selling "non-interest" bearing lake bonds to speed payment on their new lake—*South Minneapolis (Minn.)* holds garage sale to raise funds and sponsors Ice Derby on Bush Lake for same purpose—*Sheboygan County, (Wis.)* conducts winter program of painting Smokey Bear Litter Barrels and collecting used fishing equipment—*Annandale-Springfield, (Va.)* are on the way to buying 50 acre property with $500.00 down payment made and members asked to support promissory note to finance purchase—*Sioux Falls, (So. Dak.)* promotes rifle range in cooperation with City of Sioux Falls—*Pikes Peak (Colo.)* conducts Christmas tree disposal day shredding used trees for mulch in city parks to prevent soil erosion—*Garden of the Gods, (Colo.)* urges members to keep eyes open for new Grand Canyon Dam proposals—*Capitol City, (Ohio)* sells "Wonderful World of Ohio" subscriptions with 25¢ profit to treasury—*Virginia Number One, (Va.)* sponsors organization of a Skeet Club—*San Jacinto Mt. (Calif.)* works on project to tie in hiking trails in the community to those of nearby wilderness.

THE Izaak Walton MAGAZINE
OUTDOOR AMERICA

Volume 32, Number 3 March 1967

William A. Riaski, *Editorial Director*
Royal McClelland, *Editor*

Dear Sir: Your response to our request for materials for use in our Conservation Science Education Workshop was greatly appreciated. The various items which we received from you were valuable contributions to the success of our workshop. Thank you once again for your assistance and interest in our project.

Please keep us on your mailing list to receive future items which you feel may be of value in our programs.

Yours very truly,
Jerrold William Maben, Director, Conservation Science Education Workshops, The University of Akron, Akron, Ohio

All of us wish to thank you for the article "To Survive—Learn to Shoot" on page 6 of the October issue of your magazine. It was very kind of you to use it and I'm sure this information on the DCM reached a great many people who would not have normally heard about it.

We always enjoy getting your magazine. Invariably we find fresh ideas on conservation, hunting, shooting and sportsmen. We appreciate all the Ikes are doing across the nation.

Let us know any time we might be of help. All best wishes, Charley Dickey, Director, National Shooting Sports Foundation, Inc.

I was interested to read your editorial in the August–September issue which points to the electric automobile as a partial answer to the air pollution problem. As you suggest, one key to the electric vehicle is development of a better battery than is now available.

For more than two years, Edison Electric Institute and General Dynamics Corporation have been jointly carrying forward research on a zinc-air battery system which shows great promise, as indicated in the enclosed release of last December. And, as you can see from page 123 of the April, 1960 EEI BULLETIN, our industry's interest in the electric car goes back quite a few years.

Sincerely, Prall Culviner, Editorial Director, Edison Electric Institute.

Features

Departments

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CONSERVATION ON THE KLAMATH RIVER IN OREGON

By DONALD DE FOREST

OLD, PATCHED WADERS, rod, reel, an assortment of flies, my smelly old creel and a trout landing net had been waiting for me in the car. As soon as I could get away from the office, I headed out of town for Klamath Canyon.

It was a warm evening in late May. I had escaped a few minutes before five and easily reached the canyon, below the town of Keno, in half an hour. To my great joy, I found the water level was down. Therefore I could wade out safely into the middle of the wide river. Before 6 PM, I had landed two beautiful, hard fighting rainbow trout sixteen inches in length.

Although darkness did not come until 9 PM, high canyon walls had put the river in shadow after four in the afternoon. From then until dark, trout fed voraciously in the greenish waters which flow through broad meadows into the canyon from Lake Ewauna and Link River, draining more than thirty miles of Upper Klamath Lake. That these are biologically rich waters is evident from the fatness of the trout. There are other indications too.

Twenty pound rainbow trout caught in Wood River (contributary of Upper Klamath Lake), summer of 1966.

While fly casting, I tried to match the size and color of insects which were evidently hatching and rising from the waters. My difficulty was that three or four different insect hatches seemed to be occurring simultaneously. Which should I try to match? I turned and faced the western sky. Between me and its brightness hung a tremendous cloud of insects. They formed a veritable wall rising above rocks at the waters edge, reaching upward several hundred feet against the volcanic castellets and pine trees of the canyon cliffs. It was a fantastic swarm of dancing insect life, steadily reenforced by more, emerging from the river every minute. Insects were flying into my face, clinging to the inside and outside of my eyeglasses. They fell into the neck of my sweater, crawled inside my shirt and up my arms.

Frogs jumped among rocks along the shore. Crawfish were plentiful too in the fertile waters. Klamath River is beneficent to its piscine inhabitants.

Rainbow trout were my sporting objective but I knew the history of even larger game fish in this great river. There had once been bright, powerful spring chinook to be caught in the month of May, during their migratory run through the river from the Pacific Ocean, up through Klamath Lake into its feeder streams such as the Williamson, Sprague and Sycan Rivers. Fall chinook also enjoyed Klamath River and tributaries of Klamath Lake for breeding purposes.

Klamath and Modoc Indians built their civilization on the basis of abundant supplies of fish in the waters of Klamath Lake. Archeological studies indicate that such Indians have resided in this area more than five thousand years. Preserved osseous remains, three thousand five hundred years old in the Sprague River watershed, have been identified as chinook salmon. Such fish were therefore well established in the Upper Klamath Basin. Why are they no longer here?

Rainbow trout in Klamath River are the only remnant of formerly tremendous fishery resources of this magnificent river. Once there was a valuable run of steelhead trout as well as the several varieties of Pacific salmon. All of these fish found in the rich biologic resources of this watershed an ideal rearing area for their progeny. In its eastern reaches, the streams of the Klamath watershed arise on the western slopes of fault block mountains bordering the Great Basin, beginning at elevations above 6000 feet and flowing through timbered areas and broad, flat valleys (as branches of the Sprague and Williamson Rivers) to reach Upper Klamath Lake at 4,140 feet. From the north come spring fed Wood River and Sevenmile Creek, draining the eastern slopes of the Cascades, entering Agency Lake which connects to Klamath via a clear deep channel in the marsh land.

Below the point where I was fishing, downstream from Keno, Oregon, the Klamath River flows into a reservoir formed by John Boyle Dam, located about twenty miles above the Oregon–California state line. There are two other hydroelectric dams in Oregon on the Klamath River, both upstream. One is at Keno. The other is on Link River at the outlet of Upper Klamath Lake. There are fish ladders on all three Oregon dams. Not one of these fish ladders was specifically designed for passing steelhead and salmon but biologists believe that the ladders may be satisfactory for such passage if and when such fish return to these parts.

There has been no opportunity to test whether salmon and steelhead can climb these ladders since hydroelectric dams without fish ladders were placed across the Klamath River, within the state of California, upstream from Hornbrook. Three unladdered dams between Hornbrook and the Oregon line obstruct fish passage. The first of these prevented passage of all salmon and steelhead into the Oregon portion of the Klamath in the year 1917. The third California dam was installed, without a fish ladder, as late as the enlightened year 1962. Pacific Power and Light Company built this third California dam, knowing well that its Copco Number 1 and Copco

Number 2 (upstream) possess no fish ladders. Company officers had made a pact with the state of California but they gave no thought to interests or desires of Oregonians upstream. Their agreement permitted the power company to construct their Iron Gate Dam without a fish ladder on the understanding that the company would build an egg taking station and hatchery for steelhead and salmon at the dam site. There have since been court tests to determine how much annual expense of hatchery operation should be borne by the power company (and how much by California). Oregon receives no benefits from the hatchery.

It is surprising that any fishery remains in Klamath River, even below the dams. This once unbelievably magnificent river still runs free of dams from Hornbrook to the ocean. A law prohibiting dams further downstream was put on the statute books of California in 1924. However the California Water Plan (Department of Water Resources) envisions construction of Humbolt Dam (410 feet); Slate Creek Dam (775 feet); Happy Camp Dam (625 feet); Hamburg Dam (445 feet) to divert water to Southern California. These projects are probably many years in the future but if realized would reduce all of the lower river to warm water pools.

Back in the first decades of this century, fish racks were sometimes placed across the Klamath River, preventing salmon from going upstream above Klamathon (near Hornbrook). Lower Klamath River and such tributaries as the Trinity and McCloud River were once subjected to the destructive activities of monster gold dredges which completely tore up the gravel of the river bed, destroying fish habitat. Freezing the price of gold during World War II until now probably has saved parts of the tributary streams from such exploitation (but a rise in price could bring new disaster). Despite all man's depredations, migratory fish still run up from the ocean each year.

A biologic study of the Upper Klamath Basin (from Iron Gate Dam to the mile-high upper portions of the Sprague River) has been made by qualified fishery biologists. Their report (April, 1966) concludes that only the dams (by obstructing fish passage) stand in the way of reestablishing migratory steelhead and salmon runs to their ancient spawning grounds. Then the simple question is "Why can we not have adequate fish passage facilities constructed around the three California dams so that these fish may now return?"

Interested people in the Klamath Falls area have asked Pacific Power and Light Company to build such fish passage facilities. The company has pointed to the previously mentioned biologic study, insisting that their own interpretation of the report indicates that reintroduction of migratory fish into the Upper Klamath Basin would not be successful even with fish ladders, etc.

We know that the company has its eye on twenty-two miles of tumultuous, magnificent river which lie between John Boyle Dam and Copco Reservoir. Today there are no barriers here to block fish passage between the upper end of Copco Reservoir and the lowest Oregon dam. The river flows rapidly through forested canyon, with steep gradient, dropping from 3793 down to 2608 feet. The biologic survey reveals 42,000 square yards of suitable gravel for steelhead and salmon in this section of the river—enough to support about 2100 pairs of spawning adults of each species. No salmon or steelhead can spawn there now because of the unladdered, obstructing dams of Pacific Power and Light Company in California. Even with fish ladders none will spawn there in a few years if the power company is permitted to make stagnant pools of this part of the river by erecting Warm Springs Dam, Salt Caves Dam and Bear Springs Dam, as it proposes to do in time. Pacific Power and Light Company would transform the Klamath River into a series of stillwater reservoirs from Klamath Lake to Hornbrook, California.

Just how much more sacrifice must the public be called upon to make, in terms of its wildlife resources and loss of recreational facilities for the sake of hydroelectric power in this age when atomic energy is available? At Hanford, Washington, the world's largest nuclear-electric power plant has just gone on the line, developing almost a million kilowatts—which make the hydroelectric power developments on Klamath River seem insignificant. At Hanford, electric power is strictly a by-product in development of plutonium from uranium. But Argonne National Laboratory announced in November, 1966 that limitless production of useful nuclear power from plutonium is now possible commercially. Argonne's Experimental Boiling Water Reactor regularly produces electricity in large amounts, using plutonium fuel. Breeding reactors produce large amounts of plutonium and the AEC declares that by 1970 unlimited quantities will be available for regular commercial use. Plutonium up to now has been considered almost a waste-product of the fission process. So why should we persist in destroying our rivers?

Two Klamath Falls boys with typical catch of rainbow trout from Klamath River below Keno, Oregon.

Instead of sacrificing another twenty miles of river, the public could (by requiring the power company to build fish passage facilities) recoup its salmon and steelhead fishery on the Klamath and thoroughly enjoy the twenty miles of the Klamath River from John Boyle to Copco Reservoir as a recreational resource. With our burgeoning population we need to conserve, develop and restore such natural recreational facilities. Plutonium-electric developments may yet save a portion of our irreplaceable rivers and fisheries.

As things now stand, even the

residual rainbow trout fishing below Keno is subject to the whims of the power company. When control gates on the dams at Link River and Keno permit the passage of large volumes, the water level is high in the canyon, making it almost impossible to fish and certainly making it extremely dangerous to wade out into the river. The trout are worth going after, because they average about a foot in length and many of them are even larger. I have been told that men have caught rainbow over ten pounds in that section of the river. The accompanying photograph shows a twenty pound rainbow trout caught in Wood River which is a tributary of Upper Klamath Lake. This large fish is of the same strain of rainbow as in the Klamath River. Many such trout from six to twenty pounds are caught each season in Klamath Lake and its tributaries. This is further testimony of the biologic wealth of these waters of the Klamath Basin. Surely it would be wise for Americans to make decisions about fishery and hydroelectric resources individually, river by river.

The biologic study of the Upper Klamath Basin shows good spawning gravel for salmon and steelhead upstream from Copco Reservoir as follows:

Klamath River in
California . 28,500 square yards
Klamath River in
Oregon ... 13,500 Square yards
Spencer Creek in
Oregon .... 2,300 square yards
Wood River in
Oregon .... 11,000 square yards
Williamson River in
Oregon .... 5,100 square yards
S. Fork Sprague River in
Oregon .... 19,400 square yards
North Fork Sprague River in
Oregon .... 30,500 square yards
TOTAL 110,300 square yards

Allowing twenty square yards per spawning pair means 5,515 pairs of salmon and steelhead can be accommodated in the Upper Klamath Basin spawning grounds. The salmon (Spring Chinook) would migrate from February to June and spawn in the fall, not interfering with use of gravel by steelhead, which would migrate in the fall and winter and spawn in the winter and early spring.

An economic survey by Oregon State University experts has shown that such fish in the sportsman's catch are worth about $48.00 apiece to the local economy. If a return of ten or twenty thousand salmon and steelhead were attained and adequate escapement were provided, there could be five to ten thousand of each for sportsmen. This could mean an addition of one half to one million dollars to the Upper Klamath Basin economy. This is equivalent to an industrial investment of ten to twenty million dollars, but WITHOUT air or water POLLUTION, without increased school taxes or parking problems. Such an economic increase can be achieved WITH increased recreation for people already in the area (and visitors) rather than by curtailment of outdoor recreational opportunities. The greatest benefit is not economic. The intangible value is conservation of our natural heritage with restoration of the migratory fish runs. That is paramount.

In the opinion of a nonprofit organization, Klamath River Fishery, Inc., hydroelectric potential of the Klamath River has been adequately and sufficiently exploited. Members of this organization believe that Pacific Power and Light Company should be dissuaded from further dam construction on the Klamath and be persuaded now to invest sufficient funds in fish passage facilities to guarantee upstream migration of spawning salmon and steelhead and successful downstream passage around the turbines of returning young of these species. Support by conservationists everywhere is solicited in the form of letters and tax deductible contributions to Klamath River Fishery, Inc. Resolutions and communications to the Oregon State Game Commission, to your Congressmen, to the Federal Power Commission and Department of Interior and letters to Pacific Power and Light Company could prove helpful in achieving the desired conservation goals.

When salmon and steelhead again become inhabitants of the Upper Klamath Basin, come to the Klamath Basin for great sport. Fish for bright, powerful spring chinook. They will ascend the Klamath in the spring as mature adults of twenty to fifty pounds. During upstream migration these giant fish will be prized adversaries, particularly sporty in the swift waters between John Boyle Dam and Copco Reservior. They will also be taken by trolling in Upper Klamath Lake.

Or come again for steelhead fishing in the same swift, recreational waters of the beautiful Klamath River, if we can save it from further dam construction. We should then enjoy the magnificence of the grand canyon of the Klamath River where its waters move swift and deep amid forest scenes. We can breathe in the scent of evergreens and hope for the light touch of a six to sixteen pound steelhead as it seizes a cluster of drifting eggs. Once you set the hook action will begin, warming your body and your spirit as the searun rainbow dances and plunges, challenging your skill.

We who live in Upper Klamath Basin have special knowledge of the resource, but this resource is not ours. Neither is it the property of Pacific Power and Light Company. The resource is yours—a unique property of Americans everywhere. Unless conservationists and outdoorsmen and all people who realize the importance of preserving our dwindling natural fisheries get together on this immediate problem, the Klamath River in Oregon and the potential fishery (restoration) of the Upper Klamath Basin will disappear forever. Each new dam will create a warm water pool of algae, silt and saprobic worms—a biologic waste. That enlightened Americans should do this to so marvelous a creation as the great Klamath River is beyond belief in this atomic age.

We hope that you will take action to ascertain that Klamath River is preserved as a living waterway of extraordinary biologic potential—wildly turbulent and well oxgenated, capable of restoration as the breeding ground and rich rearing area for migratory salmonoid fishes. Please don't sit by silently while your Klamath River is transformed into tepid reservoirs for small, outdated power plants.

Donald de Forest
Klamath River Fishery Inc.
518 Main Street
Klamath Falls, Oregon 97601

Pest Control—A Controversial Business

Adapted from the remarks of James T. McBroom, Assistant Director, Bureau of Sport Fisheries and Wildlife, at the National Pest Control Association, Inc., Annual Convention in New Orleans.

PEST CONTROL can be a controversial business.

In this day of proper concern about the quality of our Nation's environment, many organizations that control pests are under some kind of criticism.

So, too, are we in the Bureau of Sport Fisheries and Wildlife for our animal control activities. After all, we are chiefly concerned about the conservation and protection of the wild animals in Nature. Whether it is fish or fowl, our job is to do battle to find a permanent place in the sun for wild animals in this World of stern competition for land and water. This competition, of course, results from our rapid growing population and attendant growth of industry, commerce, and transportation.

As the chief Government defender of wildlife, we have a clientele of many millions of people who have a close and critical interest in the preservation of wild animals. A large number of them don't agree that coyotes and other predators are pests.

Responding to the concerns of many citizen wildlife conservationists, Secretary of the Interior Stewart L. Udall asked his blue-ribbon group of wildlife advisors to look into the Bureau's predator and rodent control activities.

In June 1965, the Secretary adopted, as a policy guide, their report—the popularly known Leopold Report, named after A. Starker Leopold, a distinguished member of the University of California faculty, the Chairman of the Secretary's Wildlife Management Advisory Board.

Broadly speaking, the report supported the policies of Federal animal control but urged refined application of them. For example, the Secretary's experts called for improved supervision, to eliminate, among other actions:

(1) The practice of *indiscriminately* killing the largest possible number of predators;

(2) The practice of selling and promoting control activities to user groups like woolgrowers and cattlemen.

The Leopold Report made several other important recommendations—among them, expanded and intensified research in methods and techniques of animal control.

I want to give you a report on how we're doing in carrying out Secretary Udall's directive with respect to a new look in animal control.

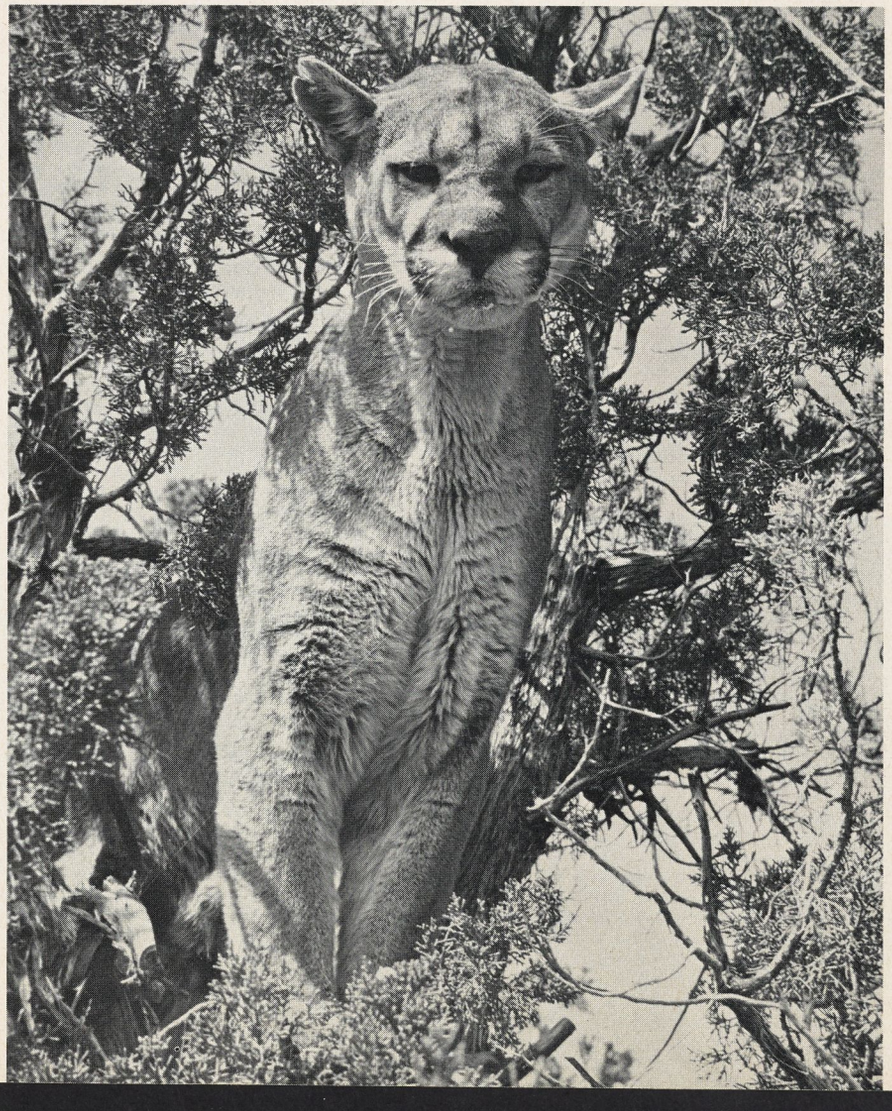
First, we are requiring written justifications for animal control programs, heretofore not required, as a part of annual state animal control plans. In a nutshell, these plans, being developed cooperatively in each State will tell where, why, when, and how animal control will be undertaken. Similarly, monthly and annual reports have been redesigned to reflect progress on specific goals outlined in the annual plan.

Second, we have issued policy instructions and are about to issue a new manual on animal control to be an operational handbook for our 800 or so Federal and cooperative employees engaged in animal control.

Third, we have asked and received concurrence by the Bureau of Land Management and the Forest Service that they, as land managing agencies, also have a responsibility for identifying land use requiring control and determining where and when animal control measures should be applied on their lands. This is as it should be. Animal control, like reforestation or range improvement, is just another tool to be used in managing lands for multiple use.

We have established, as you may

Most people like the idea of having the lithe and magnificent mountain lion as part of our animal heritage. But he causes economic damage by preying on sheep and cattle. A few months ago the Bureau of Sport Fisheries and Wildlife adopted a preventive control policy for mountain lions, where only offending animals are to be taken. Photo by W. D. Fitzwater.



know, the new Division of Wildlife Services to replace the old Branch of Predator and Rodent Control. We have called the signal to use more finesse in animal control—using the sharpshooting technique rather than the scattergun technique.

We are increasing our use of aerial hunting and flying squads to reduce damage from predators. Flying squads, by the way, are not necessarily airborne. It's just a concept of concentrating manpower and equipment from adjacent counties or states temporarily to deal in force with a predatory animal situation which may be particularly destructive in one place.

We are also striving to enrich the professionalism of our animal control force, already a capable group of professionals. Most of the $200,000 increase we received from Congress this year for predatory animal control will be used for employing college graduates in wildlife management or in allied fields to be District Field Assistants. They will actually be doing the work of reducing predatory animal populations in the field at first. Later, they will go into jobs as District or State Supervisors and thus upgrade the high professional quality of our cadre of animal control personnel.

We are acutely aware of the need for an amplified animal control methods research program. Control methods and tools, particularly in the field of bird control, must be improved. Compound 1339 was field tested last year in the West for starling control at feed lots. The preliminary results were most encouraging and it is being labelled this year for nationwide use. It appears to have limitations, however, since it is most applicable to situations where birds feed in large numbers, such as in feed lots.

There is growing concern over resistance of rats to anticoagulant rodenticides. This group of chemicals has been the strong right arm of the pest control industry for many years. Resistance has been reported in Great Britain and Haiti. If this should also develop in this country, what rodenticide will be available as a replacement? This is one area which needs investigation at the earliest possible date. Even though many rodenticides are available, none match the universal utility and margin of safety of the anticoagulants.

Although not considered as a substitute for the anticoagulants in commensal rodent control, we are optimistic that the new Compound DRC 714 will serve as a replacement for Compound 1080 in the control of burrowing rodents such as pocket gophers.

Let me get into a little philosophy about animal control.

At a time when this continent was being colonized, natural resources appeared to be limitless, and conservation, as a movement, had not been born. In many respects the endless resources, including the broad expanse of forests, the clean rivers, and abundant populations of wild animals were obstacles to man's progress; this wild country had to be tamed.

Although wild animals provided an important source of food and fiber, they often competed with man's interests. Predation of livestock and destruction of agricultural crops was then, and continues to be, a difficult problem. Man, in his struggle for survival, and the subsequent development of an agricultural industry, has been forced to control those animal populations which compete with him. In many instances, the exploitation of our Nation's natural resources, including wildlife, has been unnecessarily harsh.

We have reached a turning point in our philosophy of wildlife values. The people of this country are expressing greater interest and new appreciation in all phases of our wildlife resources. We recognize that in the complexity of this present modern-day civilization, attitudes and perspectives are changing rapidly. We must accept the fact that wildlife is to be managed not only for the consumptive segment—the sportsman—but also for the ever-increasing number of our people who simply enjoy seeing and hearing wild animals in their native habitat and knowing that a wildlife heritage exists. In short, we have recognized officially the esthetic value of all our wildlife resource, even some of the so-called pest species.

The terminology used in the past regarding animal control is archaic and no longer acceptable nor appropriate. The Bureau recognizes that animal species cannot be categorized as being either beneficial or injurious, but rather that any animal

Americans are a dog-loving people. Perhaps because of this, they admire the spunk, spirit, cunning, and intelligent appearance of the coyote. But coyotes can cause lots of damage to sheepmen. They may kill many more sheep than they can eat, just for the joy of killing and leave sheepmen with remains like that shown in the picture on the right. The Bureau of Sport Fisheries and Wildlife must balance the need to preserve the coyote as a part of our animal heritage against controlling coyote populations where the need is clearly established. E. P. Haddon photo.

can be either or both, depending upon a number of factors at any given time. Haphazard observation, personal beliefs, and prejudice should not be criteria for justifying animal control.

But, by the same token, the "Balance of nature" concept, which has been the hue and cry of the nonprofessional naturalist, is also unacceptable in this modern era. We live in an environment modified drastically by the activities of man. We must accept predators, birds, and the so-called nuisance species as important and valuable members of our native fauna; but, with full realization that there are situations in which their numbers must be controlled.

The Bureau considers animal control as an essential wildlife management function. The reduction or suppression of animal numbers is a means rather than an end; it is a means of accomplishing specific management goals, such as: preserving public health and safety, improving agricultural production, protecting natural resources, and protecting urban and industrial interests.

Like all other wildlife management techniques, animal control must be used judiciously. The Bureau's aim is to control animals when and where necessary, in the most intelligent and responsible manner possible, using the best methods currently available and with full recognition of all ecological relationships involved.

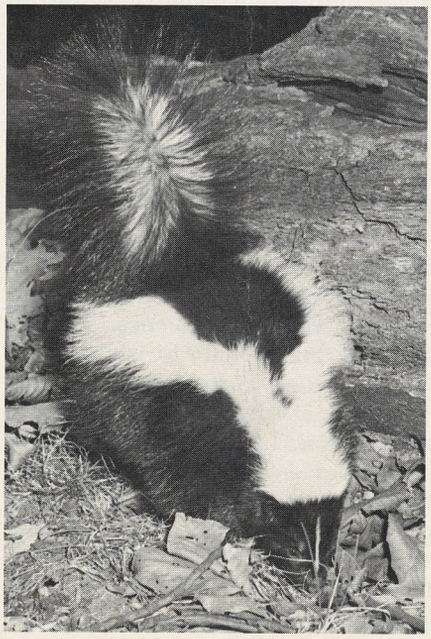
In addition to animal control responsibilities, the new Division of Wildlife Services has been assigned responsibilities in (a) pesticides surveillance and monitoring, and (b) wildlife enhancement. These activities give the Division a broader range of responsibilities in animal management than it has had before.

The fish and wildlife biologists we have assigned to pesticides surveillance operations, by the way, are available for consultation regarding potential hazards of pesticides to fish and wildlife resources. We hope that members of the National Pest Control Association will contact these biologists before using chemicals in or near aquatic sites if there are any questions regarding the hazards of pesticides to aquatic animal life.

We are currently evaluating Federal pesticide programs throughout the Nation, in cooperation with the Forest Service, the Plant Pest Control Division of Agriculture Research Service, the Air Force and mosquito abatement districts. These include forest spraying operations with insecticides and herbicides in the far West and the northern Midwest regions, a range caterpillar control program in the Southwest, and Mosquito control projects in the East and Southeast. All Federal agencies which are major users of pesticides are being advised of our surveillance program as rapidly as meetings can be made. Reports from the field indicate a willingness to cooperate with us in evaluating pesticide effects on wildlife under operational conditions.

One field study involved the evaluation of a new mosquito larvaecide, a product as yet unregistered, and was conducted in cooperation with the Dow Chemical Company. We anticipate closer cooperation with industry in field studies of this nature. This should prove to be mutually advantageous.

We are planning a series of Regional pesticide workshops. These will be invitational, and will include representatives from Federal agencies, Fish and Game Departments, State agricultural groups and pesticide researchers. These will be working meetings, not seminars, for the purpose of discussing the effects of agricultural chemicals on wildlife, and the direction which laboratory and field studies need to take to be most productive. Also, field study techniques must be improved, and methods for evaluating immediate chemical effects on wildlife under field conditions must be developed.



Skunks have an appeal as long as you stay away from them and they from you. But rabies in skunks is a continuing problem requiring control. Photo by Rex Gary Schmidt.

These new functions of the Division of Wildlife Services also include participation in the National Pesticide Monitoring Program, through collection of wildlife samples from designated sites at periodic intervals, for residue analysis. This is a companion project to our fishery program of aquatic species sampling.

The other new program in the Division of Wildlife Services which I mentioned is the one for Wildlife Enhancement. This program is being developed to cope with increasing pressures generated by an expanding population and the accompanying complex and competitive demands for incompatible uses of land, water, and other environmental resources. It has come to be recognized that the diversity of wildlife is also a sensitive indicator of a healthy environment for man himself in both urban and rural settings.

As the natural face of the Nation changes, the future of our renewable wildlife resources will depend largely upon the success of the responsible public agencies in influencing these vast environmental changes, and in influencing the attitudes of our citizens toward these changes.

We shall carry on our Wildlife Enhancement activities, providing advice and technical assistance primarily on Indian lands, military lands, and, in some cases, on private lands.

In all of these problems, wildlife enhancement can be a constructive influence on environmental change and its socio-economic impact.

A major goal must obviously be to develop not only a public understanding of wildlife, how to gain from it and enjoy it, but a "national ecological conscience."

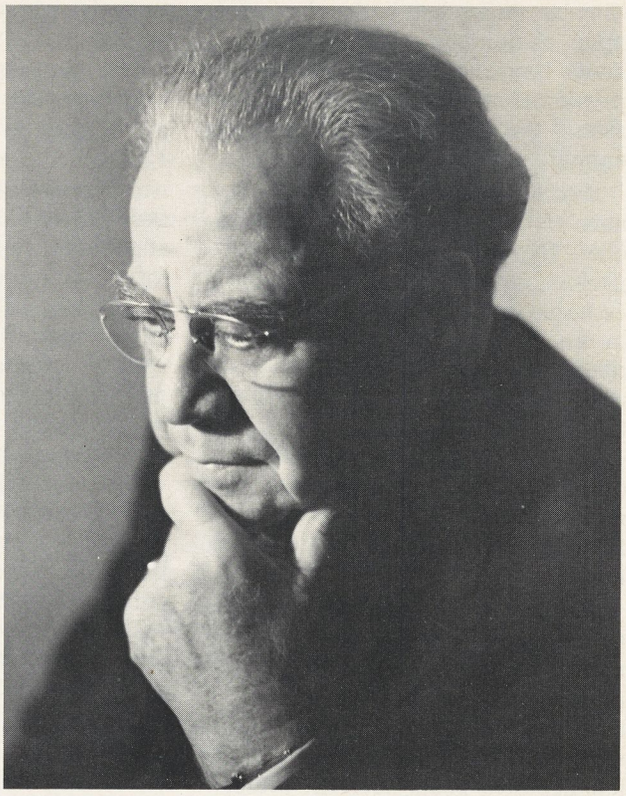
THE PLEASANT HERETIC

At the pulpit and banquet table,

DR. PRESTON BRADLEY

has a penchant for treading on toes

By Hal Higdon



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DR. PRESTON BRADLEY is a round pleasant little man with long swept-back grey hair, ponderous brows that almost overwhelm his eyeglasses, and a cherubic full-jowled face, who rarely ventures outside without either his Irish walking stick or (in place of the traditional churchman's collar) a bow tie. His is a deceptively placid visage, for the good Dr. Bradley has never shunned controversy.

"Oh yes, I'm still a heretic," he admits. "Most people think the heretic of one generation automatically becomes the fundamentalist in the next. But I still believe in heresy. I consider the true heretic to be one who entertains a suspicion against any accepted truth-a man who says, 'prove it!' "

From the pulpit of his influential Peoples Church on Chicago's north side, Dr. Bradley has been shouting "prove it" most of his life. He marched with Jane Adams in 1919 to gain women the right to vote. In the 1920's he denounced the Ku Klux Klan so fervently that Chicago police assigned him bodyguards. They feared he might be attacked. Later he angered Hitler, who refused him entry to Germany. Even today, Dr. Bradley never hesitates to raise his voice in favor of any cause that excites his interest. As a result, in addition to his regular religious duties, he is in demand as one of the most sought-after dinner speakers in Chicago—or for that matter in the world. Recently he departed on a three-month tour to South America, Africa and the Far East.

Despite his penchant for treading on toes, the single over-riding personality characteristic of Chicago's bestknown churchman is warmth. Any person, known or unknown, who stops him on the street receives a cordial greeting. "He'll treat you just as he would the President," says one friend.

Few can match Dr. Preston Bradley's skills as an orator. His vocal chords are like the keyboard of a well-tuned organ which when struck properly emits soft melodious tones. Yet like an organ he can sound gruff and powerful, and such is his oral control and the hold he has on audiences that even his whispers will fill a giant auditorium.

At the podium, Dr. Preston Bradley stands serenely, holding his dark-rimmed glasses in one hand, smoothly massaging the air with the other. Yet, when the occasion arises, he thrusts the glasses onto his straight, sharp nose and pounds the podium with his fist, not as a demagogue but more like a carpenter hammering home the last nail in his platform. And even this often monumental digressions ring home with bell-like clarity. "I have been known my dear friends" he admitted to one recent overflow audience at the Chicago Public Library (where he has served as trustee for 40 years), "to have a subject and never get around to it. I think on my feet. And sometimes I think of things more interesting to talk about and never get to the subject." His audience, which hadn't quivered a muscle in the half hour he has spoken, laughed with him.

Dr. Bradley claims that had he to state one reason for his success, it is because he likes people. One difficulty in maintaining a travelling time schedule for his 20 or more weekly speeches and lectures is, quite simply, the desire of so many to shake his hand and talk afterwards. One Bradley pet peeve (according to some friends) is the brief acquaintance who will be expecting his name to be remembered. When no name comes to mind, Dr. Bradley politely replies: "Give me a good reason and I'll remember you." And he usually does.

Preston Bradley, a son of a Linden, Michigan town blacksmith, was 78 years old in August. "I have tried to learn the art of growing old gracefully," he says. "More people should try it. Some of the oldest people I know have been 30 years old." He gave his first sermon in the Linden cemetery from a marble tombstone atop which was carved an open Bible. He and his younger sister's friends would gather there and young Preston would stand, his head barely showing above the stone, and preach to them. Later while attending Alma College, he worked as a circuit minister, riding horseback and preaching in three churches each Sunday. Brad-

ley earned a law degree at Flint College, then enrolled at Chicago's Moody Bible Institute. He was ordained a Presbyterian minister in July of 1912, but only after having been suspended once for theatre-going and pipe-smoking. The suspension failed to purge him of these supposed vices and his pipe today remains as much an outgrowth of his personality as his bow tie and walking stick. One tobacco manufacturer has even packaged a special pipe mixture and named it after him.

In a recent autobiography with Harry Barnard entitled "Along the Way," Dr. Bradley talks of these formative early days and how, as a boy, he visited churches and auditoriums to hear the great preachers, lecturers and public figures of the day. One memorable experience he relates was in travelling alone to Detroit at the age of twelve to hear the great orator William Jennings Bryan. But by 1912, Bradley had his own pulpit, the Church of Providence on Chicago's north side. He held it less than a year. In one sermon he attacked the idea that christening was necessary for salvation. Someone in the audience tattled, and charges of heresy were filed with the presbytery. Dr. Bradley didn't await trial. A self-admitted heretic, he resigned from the Presbyterian Church to form his own "Peoples Church." Eighty-six of the hundred members of his congregation joined him. He maintains his independence today, although in 1923 he affiliated with the Unitarians and in 1959 added affiliation with Congregationalists as well.

The early history of Dr. Bradley's congregation consisted of a series of moves into ever-larger rented halls until construction of the current Peoples Church building in 1926. The Church's Sunday services have been broadcast continuously on radio since 1922. The present congregation numbers 4,600. Dr. Bradley says: "The average duration of a Protestant minister in one church is seven years. It takes a Protestant preacher that long to tell all he knows, or get found out." He has occupied his pulpit 54 years, longer than any other churchman in Chicago.

"If more preachers would be as human in the pulpit as they are when holding a fishing rod," writes Dr. Bradley, "there would be many less empty pews. It takes the same technique to be a successful fisher of men that it does to be a successful fisher of fish. I have learned after 55 years of fishing experience that to be a successful fisherman one must select his bait with the viewpoint of the fish in mind, rather than of the fisherman."

From the beginning, Dr. Bradley has been opposed to the fire and brimstone theory of religion as well as to the concept of unbending rules and doctrines. "He's a liberal all right,"? says Wally Adams, a member of Bradley's church as well as of his Lions club. "It's fair to say that he was the forerunner of what is happening today in the religious community. You might even call him one of the pioneers of the present ecumenical movement."

Dr. Bradley has welcomed to his pulpit leaders from all other Protestant faiths, as well as Buddhist, Jewish, and Catholic. "In my view," he says, "the liberal is concerned with Christianity as a way, not as a creed; as a life not as a system. I have concluded that the true liberal should work with any individual or organization that tries to make articulate the voice of Jesus in this age in helping to solve the problems of the here and now."

About his membership in the Lions club of Uptown Chicago, Dr. Bradley says: "I've been interested in the Lion movement for many years. I was in from the beginning. Melvin Jones, the founder of Lions, was my best friend. I went to San Francisco in 1945 with him as an advisor to the State Department at the time of the founding of the United Nations. Later I preached his funeral sermon."

In keeping with his maverick nature, he refuses to wear galoshes or rubbers even in abominable weather. He dislikes flying and has crossed the Atlantic Ocean 58 times by boat. Although he suspects he may have eaten more chicken a la king than any other individual in the city of Chicago, he enjoys good food, particularly if it is Chinese and manipulates chop sticks as though raised in Hong Kong. People occasionally mistake his Irish walking stick for a shillelagh, but no, he tells them, a shillelagh is more like a tomahawk and his cane is actually furze. Yet it occasionally does service as a shillelagh when he bangs it on the fender of a taxicab failing to yield him the right of way as a pedestrian.

The list of his accomplishments is a long one. He has published nine books. He is a member of the Mayor's Commission on Human Relations in Chicago. He was appointed by the Governor as a member of the Prison Investigating Commission of Illinois. As a founder, he gave the Izaak Walton League of America its name and was three times its president. He is a life member of the Chicago Art Institute, the Adventurer's Club, and the Chicago Historical Society. He has been asked by both political parties to become at various times mayor, state representative, and a candidate for the U.S. House of Representatives. "He is a citizen of the world," says Wally Adams.

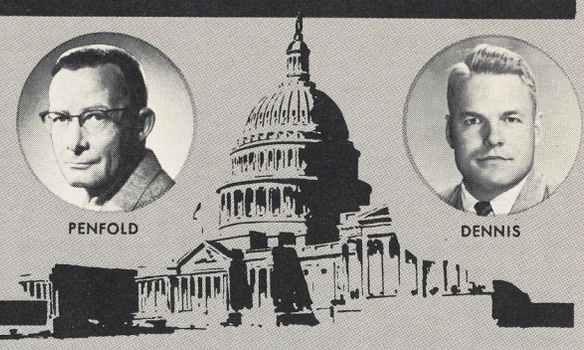
Dr. Preston Bradley is the occasionally angry man with the warm handshake. He remains a self-confessed heretic, but also a warm romanticist who likes people. "There is a major theme in every man's life," claims Dr. Bradley. "Everything you do in your life is a variation on it. I've never been interested in being with the majority. I've never made the mistake of thinking bigness and greatness are the same. I would rather have it said of me: He tried to be a friend of all mankind."

Gene Lovitz photo.

THE WASHINGTON PAGE

Where League policy is involved, all facts & statements on this page are official

Joseph W. Penfold, Conservation Director
Robert T. Dennis, Assistant



ON CLEAR DAYS . . . WHAT CLEAR DAYS?

THE NATIONAL CONFERENCE on Air Pollution was held during December in Washington. Its 3000 delegates reached the same general consensus as did a previous conference four years earlier: the air is getting dirtier all the time; this is a dangerous situation; we ought to do something about it.

Vice President Humphrey laid it on the line in his piercing opening address—if we have engineers capable of providing the "atmosphere" to sustain astronauts, then we ought to be able somewhere to find engineers who can prevent air pollution here on Earth.

Later, however, the Conference seemed to go adrift. Indeed, as cigarette haze built to tolerance threshholds in the meeting rooms, answers to "how, by whom, and when" grew murkier. Public personnel talked about beefing up State programs, interstate cooperation, and stricter emission standards. Industry generally said that both air quality criteria and the Federal Government are undesirable, and that further research is needed. And, there were strong suggestions for continued air pollution abatement by dispersal—super tall stacks—reminiscent of the theory that "dilution is the solution to water pollution." Anyway, conferees either chose up sides or retired in confusion.

Edmund S. Muskie of Maine, Chairman of the Senate Subcommittee on Air and Water Pollution, made a yeoman effort to restore order at the Conference banquet.

"The time has come," he noted, "for us to take a new look at our air pollution control policies. We have the same relationship to air as fish has to water. A fish in a stream cannot avoid the pollution in that stream—although we may. By the same token—unless we want to wear gas masks—we cannot avoid the air around us. . . .

"More and more Americans are willing to pay the cost of controlling pollution rather than suffering the penalty of inaction. We must decide how best to pay the cost of control and how best to organize our efforts. And those decisions will depend on how we define our goals.

"To date, we have set limited goals for ourselves. We have focussed on individual pollutants, their weight, their amount, and their immediate and observable effect. . . . We have passed ordinances to remove smoke; we have planned limitations on sulfur content in fuels used in certain cities; we have taken abatement action against specific polluters. These were necessary first steps, but they are not adequate. . . . The American people are not really concerned about the source or the composition of dirty air. They want clean air. . . ."

Then, Senator Muskie suggested action. First, he said, let us adopt national ambient air quality criteria, apply them as standards within meteorlogical airsheds, and implement them through enforcement of emission standards. And he argued that the old institutional arrangements for air pollution control ought to be updated through formulation of new approaches to local- State-Federal cooperation.

The issues facing the people and Congress appear pinpointed:

1) Physically, air pollution is much like water pollution. The sources are much the same. Both carry broad environmental implications. Both can be prevented.

2) Socially, however, air pollution "control" must perhaps be approached differently than we are handling water clean-up. State interest in air pollution is barely in its infancy—probably a quarter of a Century behind State clean water concern. And if, as some suspect, atmospheric pollution by carbon dioxide can radically change the Earth's climate, the need for strong Federal and international action is obvious.

3) As Senator Muskie pointed out, a fish cannot avoid dirty water. A man can—by choosing not to go swimming and boating and by drinking only from treated supplies. Man cannot avoid dirty air. In setting water quality standards to maintain a healthy fish population, we are really calling for naturally clean water. To maintain a healthy people population, we must also accept as our standard naturally clean air.

4) This means we must dump nothing into the air, an ultimate goal not even accepted yet for water. In programming for clean air, it would be folly to repeat the decades of errors made in the water pollution field.

5) So who should get the job? The local communities can't do it alone—the New York citizen may be breathing dirt from Chicago. Nor can the States. Interstate arrangements might be useful. But the ultimate interstate arrangement, of course, is the Federal Government itself.

6) Thus, it seems clear that the Federal Government will need to move quickly, effectively, comprehensively on a program within which the States and local communities can play as full a role as their capabilities and determination permit.

7) When respected scientists suggest that within 100 years we may air-pollute ourselves off the face of the Earth, it is no time for half-way, let's-wait-and-see measures.

FEE FISHING—GROWING

ILLINOIS ANGLERS paid about a half million dollars to fish at fee areas last year, according to a report released recently by the Division of Fisheries, Illinois Department of Conservation. In 1966, the Department of Conservation licensed *178* areas.

Fishermen may pay an annual membership fee, a daily fee or for the pounds of fish caught. Annual memberships cost from $10 to $400 a year. Daily fees ranged from 90¢ to $3, and the poundage rate varies from 60¢ to $1.75, depending upon the species of fish desired. Trout are the most expensive.

The majority of area operators reported a gross income of $100 to $2,000 annually. Twenty areas grossed $5,000 or more and one area reported $106,000.

Although a few areas reported that they did not stock fish regularly but depended upon natural reproduction to provide sport for the angler, the more successful ones stock their waters heavily, as high as 2,000 to 5,000 pounds of fish per acre. Carp, bullheads and channel catfish are the species most commonly stocked, but trout, largemouth bass, bluegill, crappie and sometimes walleye are also released in numbers.

Operators report that disease is not an important danger in the crowded waters because of a rapid turnover in the population. From 50 to 100 per cent of the fish released are caught by anglers. Fish for stocking are purchased from private hatcheries or commercial fishermen.

Artificial ponds or lakes are the most common water supply at fee areas, although some operators reported that they utilized strip mine lakes and, gravel or clay pits, borrow pits and river bottom lakes. Water areas of two acres or less can be fished and managed more efficiently than larger bodies of water, according to area owners.

Most areas have regulations more stringent than state law, restricting the kind of gear or bait, number of poles, etc. Area owners generally agree that a fee fishing area must be located within 25 miles of a metropolitan center and must stock large numbers of fish to be successful. Many areas provide camping or picnic grounds, playgrounds for children, concession stands and swimming beaches. One in northwestern Illinois has an outdoor summer theater.

FROM EXTINCTION TO ABUNDANCE

A LITTLE BIT of luck might nullify a threatened catastrophe, but it takes a special talent to turn disaster into genuine asset.

The Missouri Conservation Commission and specialists for the Department of Conservation did just that, however, when they found one of Missouri's finest and best-known warm-water fisheries heading for extinction.

Lake Taneycomo was justly famous for its bass and crappie fishing. That was before Table Rock Lake was impounded just upstream on the White River. The cold discharge from the high Table Rock dam cooled Taneycomo, and as temperatures dropped the populations of warm-water fish dwindled. Fishermen, resort owners, area residents, and businessmen of Branson could see only a bleak future.

Then the Conservation Department's biologists realized that the cooled water in Taneycomo would be just right for rainbow trout. Trout were stocked in the lake and watched carefully. They found a home, and set up housekeeping.

The Shepherd of the Hills country had a new, bright future.

From 1958 to date, 2,916,500 trout have been stocked in Taneycomo. In 1965, the latest year for which angling figures are available, fishermen caught 282,000 trout. Those 151,300 anglers also gladdened the hearts of Branson businessmen.

But success did not go to the heads of fisheries management people in the Conservation Department. Three years ago they realized that not all the lake was being used by the trout—there was some lake left over, and extra lake might provide some extra fishing.

They introduced kokanee salmon in the hope that the kokanee would be able to use the parts of the lake that trout did not care for. Last year, for the first time, substantial numbers of salmon were caught, indicating another success and providing another attraction for the Lake Taneycomo area. So far 1,300,000 Kokanee fry have been stocked in the lake, and another 500,000 eggs will be received this winter for hatching and stocking the lake.

One of the more pleasant aspects of the Lake Taneycomo story is that the program is self-sustaining. The trout fishermen pay for their trout fishing with their purchases of an annual $2.00 trout permit.

That is the Taneycomo story: From threatened disaster to a nationally-famous fishery in eight years.

JUNIOR FIRE PROGRAM ORANGE COUNTY, CALIFORNIA

A TREMENDOUSLY successful program of teaching fire prevention in the highly vulnerable fire hazard areas of California is continuing with an impressive 14 year record in Osage County, California.

State and County officials emphasize that the success of this junior educational program has been due to the fine cooperation of many state and local agencies. The Izaak Walton League has played a key role along with substantial aid from The Sears–Roebuck Foundation.

The report for the 1965–66 school year shows a total of 731 programs were conducted cooperatively by the California Division of Forestry, Orange County and City Fire Departments and school officials. Teacher training was a big factor in creating participation with a total of 744 teachers given special instructions. 21,544 students completed requirements for badges supplied by The Sears–Roebuck Foundation.

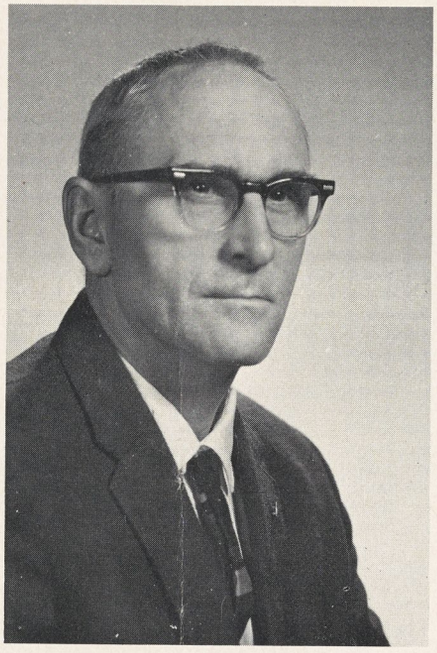
Included in the program is a very comprehensive and practical manual entitled "You Against Fire". This manual is profusely illustrated with drawings and pictures. Teachers and students participate in field trips which include equipment demonstrations and actual fire prevention work.

HOW RICH ARE OUR WATERS, AND WHO IS RESPONSIBLE?

By Jacob Verduin

Southern Illinois University, Carbondale, Illinois

AMONG OUR pollution problems there are many diverse influences, and quite a few of them involve direct addition of toxic materials to our environment. Examples are: acids from mines and industries, and the gases that emerge from our exhaust pipes and flues. But in water pollution one of our most serious and widespread problems arises, not from toxic wastes, but from the increased plant nutrients that are entering our waters. When I first became interested in water biology (1948) scientists were expressing amazement at the low levels of phosphorus in water, and at the fact that algae were able to extract this essential nutrient from such a dilute solution. My first graduate student at the F. T. Stone Laboratory (The Ohio State University, Put-in-Bay, Ohio) which is located on an island in Lake Erie, was Herbert C. Curl. He is now in the Oceanography Department at Oregon State University. Herb studied the phosphorus supplies in western Lake Erie and found that they were frequently less than 10 micrograms per liter (parts per billion!!). Yet the lake had rather good crops of algae. The nitrogen content of the water in those days was about 2,000 micrograms per liter. Today the average phosphorus supplies have increased four-fold, and the crops of algae reach nuisance levels every year. Nitrogen, during the same period has increased by only fifty per cent. So you can understand why the phosphorus increase is believed to be primarily responsible for the increased growth of algae. Similar enrichment has occurred in most lakes and reservoirs in the U.S.A. The nuisance growths are usually more severe in small lakes and reservoirs than in a lake as large as Erie. When people realized that a great lake such as Erie could be seriously damaged by our fouling of the environment, then even the most thick-skulled exponent of "Free Enterprise" began to realize that something had to be done!



Jacob Verduin

What kind of nuisances result from increased algal crops? These nuisances are of several kinds. (1) Have you noticed foul tastes and odors in much of our drinking water? These are usually caused by algae. (2) Have you observed, and smelled, rotting windrows of plant matter on our beaches? These give off foul odors and serve as a breeding ground for flies. They are caused by heavy growths of plant matter which rise to the surface and are deposited on beaches by wind-driven currents. (3) Have you seen, or heard tell of, catastrophic kills of fish, and other aquatic life? These are caused by oxygen depletion during the decline of an algal population. Then the organic matter produced by the crop is attacked by decay organisms which consume oxygen in the process, and there isn't enough oxygen left to supply the usual forms of aquatic life.

In this entire picture of enriched water and its undesirable consequences phosphorus is the key element. It used to be in such short supply that it kept aquatic plant growth within reasonable bounds. But in the past 20 years the supplies of phosphorus have increased about four fold. I have surveyed data from 130 stations over the U.S.A. (data supplied by Dr. J. B. Anderson, of the Federal Water Pollution Control Administration) and I find that most of the waters sampled have phosphorus supplies close to 100 micrograms per liter, and many are near or greater than 200. Aquatic plant ecologists have estimated that 20 micrograms per liter is sufficient to set off a nuisance level of plant growth! Most of our waters have 5 to 10 times that much! Before the phosphorus increases occurred we had occasional problems, but what was a fairly manageable situation has become almost unbearable.

Where does the additional phosphorus come from? We can identify three major sources: (1) Increased urbanization, with its flush toilets and garbage disposal units, has added increased amounts of organic matter to our sewer systems. Even when sewage is well treated and digested in the most modern plants the phosphorus supplies remain in the effluent and increase the fertility of our streams. (2) The use of detergents is responsible for a large contribution. Modern detergents contain a large amount of phosphate. This is true also of the new bio—degradable variety. It is estimated that more than half of the phosphorus in the sewage effluents of our cities comes from the detergents used in our automatic clothes and dish washers. (3) Farmers are using chemical fertilizers (mostly nitrogen, phosphorus, and potassium) in increasing amounts and enough phosphates appear in the drainage from farm land to make an important contribution to our enriched waters. I have tried to estimate the relative amount contributed by each of these three sources to the total phosphorus supply in our waters today. The best estimate I can obtain from data now available is:

Detergents, about ½ of the total
Farm drainage, about ⅓ of the total
Organic matter in sewage, about 1/6 of the total

This breakdown suggests that removal of detergent phosphorus would reduce our nutrient enrichment by about one-half, and I think our detergent industry should

double their efforts to find a substitute for phosphates in the detergent package. Representatives of the industry tell me that they are aware of the problem and are seeking a solution. They have assured me that they will look at substitutes other than white lead, mercury and strontium-90. Personally, I don't think our civilization would be seriously impaired if our wives went back to good old Ivory Soap (99.44% pure) on wash day, and in doing the dishes. This sacrifice would represent a big stride in the direction of reduced enrichment of our waters. But even then our waters would be too rich for comfort, and additional measures will be necessary.

An encouraging set of data are now available on our sewage oxidation ponds. Under summer conditions these reduce phosphorus levels by about 80 per cent. A number of small towns, now, are using these "lagoons" as their only method of sewage treatment, with encouraging success. If such a lagoon can serve as a complete sewage treatment unit, and provide a marked removal of plant nutrients in the process, then it seems likely that a lagoon, receiving the effluent from a modern sewage treatment plant, would serve as a nutrient removal process before releasing the sewage effluent to our streams and lakes. Such a lagoon would also provide a sort of "Safety valve" for the raw sewage that is bypassed by most of our sewerage facilities during heavy rains. I believe that one of the first practical steps to be taken in attacking our pollution problem is to proceed with construction of such lagoons wherever a town or city can find a suitable site for one. The technology of their construction and management is well established, and even in the present state of our knowledge we can be sure that such lagoons will provide distinct improvement of the effluent water.

However, research is in progress, and more will undoubtedly be undertaken, to improve the "cropping" of these lagoons. One of the plant groups that has been neglected in such research is the filamentous algae (Pond Scum). These are capable of rather rapid growth, and they float on the surface, making it easy to harvest them. It should also be possible to break up the filaments of a suitable strain and use these fragments as "seed" to innoculate a lagoon with the desired variety for best nutrient removal and easiest harvesting characteristics. Eventually I hope we would discover a practical use for the harvested crop. My friend, Dr. Wm. Gray, of the So. Ill. Univ. Botany Department, is building a pilot plant to investigate the conversion of waste carbohydrate materials to proteins by the culturing of fungi on such substrates. He plans to use filamentous algae of the kind that deposit on our beaches, along with many other waste materials, in these investigations. In the long run, then, our nutrient-rich sewer effluents may prove to be a source of much-needed protein.

I can't see any easy solution to the phosphate contribution from our farms. Although it is an important fraction of the total supply in our waters (about one-third) yet it represents only about 1–3 per cent of the phosphate a farmer applies to his land, so it is not a serious economic loss to him. He is likely to continue adding phosphates as long as their use more than pays for their cost. Eventually it may be necessary to construct lagoons at the mouths of all our streams so that a process of nutrient reduction can be applied before the waters are allowed to enter lakes, or oceans. The fouling of our ocean beaches and the catastrophic "Red Tides" which have become so notorious are the result of this same phosphorus increase in the inflowing waters. Such a program of lagoon construction would be expensive, but it would serve a number of useful purposes. In addition to reducing nutrients to manageable levels, these lagoons would serve as siltation basins, thus prolonging the life of lakes and reservoirs. They would provide additional sources of fresh water for home and industry near the oceans, and, believe me, it is a lot less expensive to hold fresh water a while so you can use it before it runs into the sea, than to convert sea water to fresh! And, finally, such lagoons would provide attractive water recreation areas. They would be excellent for boating, skiing, swimming, etc. They would provide fine marina harbors, near lakes and oceans. They would support large fish populations, especially of the "rich-water" varieties, usually called "pan-fish", in contrast to the more gamey fish that we would hope to maintain in our lakes and oceans as a result of the reduction of nutrients to manageable levels.

Jacob Verduin is Professor of Botany, Southern Illinois University, Carbondale, Illinois.

Potomac Clean-up

Secretary of the Interior Stewart L. Udall, announced that a $1,650,000 grant has been awarded to the Washington Suburban Sanitary Commission to help build one of the most advanced waste treatments plants in the world.

Secretary Udall said that construction of this plant at the Suburban Sanitary Commission's existing Piscataway Wastewater Treatment Plant is a major step in a program now being developed to clean up the Potomac.

The Secretary noted that this site on Piscataway Creek in Prince Georges County will be particularly helpful in reducing pollution of the waters in the area of Mt. Vernon, across the river on the Virginia shore.

Mount Vernon has long had signs up warning visitors of the polluted condition of the Potomac River.

The Washington Suburban Sanitary Commission has a new secondary waste treatment facility at its Piscataway plant which has not yet been placed in operation. The tertiary or advanced waste treatment facility to be built with the aid of the Federal grant will enable this plant to transform wastes into water almost pure enough to drink.

Research by the Federal Water Pollution Control Administration and others, Secretary Udall said, has shown the technical feasibility of obtaining a far better degree of treatment of wastes than is now generally provided.

This research so far has been primarily at the laboratory and small pilot plant scale, but is now ready to proceed to full scale operation.

An Affair of the Heart

From: *Mississippi Game and Fish*

THIS IS A story of love. There are no grand passions in this story, nor are there any tragic heartbreaks, tender love songs, or sonnets to beauty. But just as surely as love exists, just so surely this is a story of the heart.

I do not know when or how it began. Perhaps it started on a raw November night when the whistling wind pushed the black, low-flying clouds against the mirror of the half-hidden moon, and a barefoot boy walked out of sleep to run outside and stand shivering, watching long after the haunting cry of the southbound geese had faded away.

Or maybe it began when deep called to deep and a beloved foxhound lonesomely and melodiously let her young owner know old red fox had been there. Perhaps it was this feeling of worship felt only by a foxhunter when his dog strikes that started this love story.

Or again, perhaps this story started with the chill of an early January morning reaching through insulated clothing to the marrow of the bones in the still blackness of early dawn. Perhaps the quiet wait for shooting hours and the sudden whistle of a low-flying mallard started it all. Or it could have been the incomparable thrill of giving the quiet feeding chuckle and watching wings dip gracefully to brake among bobbing decoys. I do not know.

I remember it could have been the elation of watching the first pointer I ever handled come into the strong scent that electrified him and froze him into a liver and white statue before the background of the brier-covered fence row. Perhaps it was the satisfaction of a clean double and a matchless retrieve. This could have started it all.

Or it could have been the matchless grandeur of watching an old buck feed through a willow break. Or it could have been the anger of a bull bream fooled by a popper. Or the urgent flurry of a minnow before a crappie popped the cork.

I do not know where it started, but I do know that since it began, this love story has never let me walk down a road without stopping to watch the little brown field mice busy in their network of highways and factories, or to listen to the sparrow chatting with her neighbor about the nosy jay bird next door.

And it never lets me see a dawn rise without remembering with a twinge of the heart the glory of an early morning when the beloved hounds pushed the old red fox across a meadow glistening with dew, while an awe-filled boy watched in reverence from an over-grown fence row.

Nor can I watch a pair of proud, handsome bobwhites douse themselves in the roadside dust on a hot August Day without a stirring of memory to the communion of a man and his pointer.

Nor will I ever listen to the angry, staccato talk of an old red squirrel fussing at the world without remembering the silence of a majestic mast tree forest, the sudden loud bark of the .22, and the thud of an old patriarch as he fell from his lofty perch to hit the moss-covered softness below.

This affair of the heart always listens for the sound of a feeding mallard when driving through marsh country. It looks with accustomed eye across the prairies and fields to spy the movement of a whitetail. Every windy fall night this love will not let sleep come listening for that lonesome cry of the high-flying Canadians. And on every lake and pond it looks for the telltale ripples of feeding bass.

This love never lets me pass my boys at night, sleeping in peaceful contentment and innocence, without pausing to wish for them that they too might feel some of these things and have some of the reverence for these moments. I covet for them all the golden days that come from such a love story, that they might know this communion of heart to heart in all its fullness.

Where will this story of love end? I do not know any more than I know when it began. I only know that this is My Father's World and that I think I love Him and His Mankind a little better because of this love. And I would like to think that someday I will know the fulfillment of these moments when I hear His Voice saying "Inasmuch as ye have loved one of the least of these, ye have loved me."

Yours for more love stories,
Murray Etheridge
Pastor, Merigold Baptist Church

GRAND CANYON DAMS LEGISLATION

Congressman Richard L. Ottinger (D-NY) has introduced legislation to bar the Federal Power Commission from licensing two controversial hydro-electric dam projects that would flood the Grand Canyon.

"The decision to sacrifice the Grand Canyon to commercial exploitation ought to be made by Congress, if at all," Congressman Ottinger said. "The Grand Canyon is far too important a part of our American heritage to be left to the mercies of a quasi-judicial Federal commission."

"I am particularly concerned since the FPC has, as yet, not demonstrated that it has the qualifications or the mandate to weigh the vital conservation, recreation and historical issues involved," he added.

Congressman Ottinger's bill would extend for three more years the moratorium on FPC licensing power passed by Congress in 1964. The moratorium was proposed by Senator Carl Hayden (D-Arizona) to prevent the FPC from approving applications by the Arizona Power Authority and the City of Los Angeles to construct dams at Marble Gorge and Bridge Canyon. When the moratorium lapsed on December 31, 1966, the pending applications were revived before the FPC.

Congressman Ottinger noted that a plan to authorize the Bureau of Reclamation to build the power dams was proposed in the 89th Congress but failed to come to the Floor of the House in the face of widespread opposition.

The issue won national attention last year when the Internal Revenue Service threatened to revoke the tax exempt status of the Sierra Club, a leading conservation organization, for its opposition to the administration-supported measure. Congressmen Ottinger led a Congressional protest against the ruling and, when the exemption was revoked last month, threatened a further challenge.

Hydrologic Problems Following 1964 Alaska Earthquake

The U.S. Geological Survey has released reports describing what happened to Alaska's lakes, streams, and ground water following the 1964 "Good Friday" earthquake.

Separate reports, "Anchorage" and "South-Central Alaska," by Geological Survey hydrologist, Roger M. Waller, of the Survey's Albany, New York, office, show that the earthquake had severe and disrupting effects on many aspects of the hydrologic regimen.

"The extent of the hydrologic effects was possibly the greatest that has ever occurred on the North American Continent and probably the greatest ever recorded," said Waller.

Waller noted that:

Lake and river ice was broken for distances of 450 miles from the quake's origin as a result of seismic shock and oscillation of water in the lakes.

Ground water, laden with sediment, erupted through cracks in the ground. The extrusions caused local cratering and land subsidence due to compaction from the loss of sediment and water.

Landslides and snow avalanches temporarily blocked streams and diverted some permanently.

Ground water was affected in unconsolidated soils for distances of 160 miles from the earthquake point of origin. These affects included failures of well systems and "muddying" of well or spring supplies.

Artesian pressure levels dropped near Anchorage as much as 15 feet.

Water quality was not changed except for temporary increases in muddied-water in wells and streams.

Effects on water-saturated clays that underlie Anchorage led to the disastrous landslides and ground fracturing.

The U.S. Geological Survey has been conducting water resources studies in the Anchorage area for about 15 years. Its network of observation wells and stream-gaging stations provided preearthquake data for assessing the effects of the shock.

Ground-water supplies in the Anchorage area for municipal and private use were disrupted immediately and some long-term effects have been observed. The total ground-water yield of the area may have been reduced slightly.

Waller noted however that the dual use of surface and subsurface water supplies was proven to be a good insurance.

"Even though both sources were partially disrupted, together they provided a continuous supply of water," he said.

The hydrologic report on Anchorage, published as Geological Survey Professional Paper 544-B is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 at $.60 per copy.

The report on South-Central Alaska is published as Geological Survey Professional Paper 544-A and is available from GPO at $.30 per copy.

Both reports are well illustrated with photographs, maps, and graphs. The reports are part of a series of comprehensive publications by the USGS which describe geologic and hydrologic aspects associated with March, 1964, Alaskan earthquake. More than 40 such reports are planned.

Value of Duck Hunting?

A Putnam County, Illinois, Circuit Court ruled that Duck hunting was worth $47,999.82 to property owners adjoining the power line of the Central Illinois Light Company. Damages in this amount were awarded to several property owners who contended that lands owned by them up to one half mile away from the power line were damaged for duck hunting purposes since ducks would not fly near steel towers and electric transmission lines.

There are thousands of school teachers that could make very good use of "Guidelines"—see below.

UDALL DECLARES FEDERAL JURISDICTION OVER OUTER CONTINENTAL SHELF RESOURCES

SECRETARY OF THE INTERIOR Stewart L. Udall has announced that he is formally reaffirming the Department of the Interior's statutory and constitutional jurisdiction over all undisputed areas of the Outer Continental Shelf of the United States.

This jurisdiction, he said, includes oil and gas exploration, development, and production; exploration and development of other mineral resources; protection of recreational and esthetic values, aquatic resources, and other public resources.

One of the first efforts, he indicated, would be to seek with the States the establishment of a system of formal cooperation in the proration of oil production in those Outer Continental Shelf areas adjacent to States with proration systems.

While emphasizing the need for formal action by the Federal Government, Secretary Udall stressed his intention to continue cooperation with State conservation agencies. He said, "It is our hope to formulate and administer these orders in a manner compatible with conservation principles accepted by the interested States, but we must also recognize the Federal ownership and responsibilities on the Outer Continental Shelf." In letters to the Governors of Texas and Louisiana, he requested their advice and assistance in drafting formal orders relating to oil production.

With the Supreme Court decree in *United States vs. Louisiana*, Secretary Udall said, it has become apparent that the Federal Government must formally assert its exclusive jurisdiction over those areas of the Outer Continental Shelf lying seaward of the State boundaries as fixed by the Submerged Lands Act of 1953.

Congress assigned full administration of the area to the Secretary of the Interior in Section 5 of the Outer Continental Shelf Lands Act of 1953. Over the past 13 years, the United States has exercised its jurisdiction by informal negotiations and arrangements with the States.

An order is being published in the Federal Register to assert formally the conservation jurisdiction of the United States. It also sets up a time schedule for the development of the new proration system for the Outer Continental Shelf. Proposed rulemaking will be made on or about March 1, 1967, with General Orders, as finally approved by the Secretary of the Interior, becoming effective on or about July 1, 1967.

As a point of clarification, Secretary Udall said the order being published in the Federal Register would not apply to public and acquired Federal lands within the boundaries of the States and applies only to the Outer Continental Shelf entirely outside of State boundaries.

HUDSON PASSES OLDEST FOREST ON ITS 300-MILE TRIP

AT LEAST SIXTY rivers in the United States travel farther than the Hudson but in its short length the river discovered by Henry Hudson crosses terrain of astonishing geologic diversity and complexity.

The Hudson's 300-mile course takes it through five distinct geologic regions and past a sixth. Near its banks are one of the largest garnet deposits in the world, the remains of the oldest forest ever discovered, and examples of one of the original forms of life on our planet.

At the end of its journey, the Hudson glides by a tiny region whose mineral resources exceed that of any other known area of similar dimensions—metropolitan New York.

The six geologies of the Hudson are described in an article in the January issue of *Natural History*, which is published for The American Museum of Natural History. Author Christopher J. Schuberth is a member of the Museum's Department of Education.

The Hudson's geological journey begins at Lake Tear of the Clouds, a small Adirondack lake nestling in a basin on the southwest flank of New York State's highest peak, 5,344-foot Mount Marcy. Passing through the Adirondacks, the Hudson flows over some of the oldest rock in North America. The Adirondacks are composed primarily of rock dating back to Precambrian times of more than 1,100 million years ago.

Grove Mountain, and Adirondack peak on the west shore of the Hudson near North Creek, has one of the largest deposits of garnet in the world. Garnet crystals averaging four to five inches in diameter are taken from the Barton Mines.

The Hudson leaves the complex Precambrian geology of the Adirondacks behind at Glen Falls, when it enters the Folded Appalachian Mountains. This region is called the Hudson Valley or the Great Valley.

At Saratoga Springs, 12 miles west of the Hudson in the Folded Appalachians, are beds of fossil algae, or Stromatolites, which look like large Brussels sprouts. The Stromatolites are a graphic reminder that the area was once an isolated part of an intertidal zone, the salinity of which was even higher than that of the open sea.

The fossil algae of Saratoga are "only" about 520 million years old but Stromatolites that occur elsewhere in North America come very close to representing the earth's oldest remains of life—some 2,000 million years old.

Beginning at Troy, the Hudson becomes an inlet of the sea—an estuary. Ocean going vessels that ply the estuary's 32-foot-deep channel and dock as far north as Albany rise and fall on a four and one-half foot tide.

A few miles southwest of Albany, the Hudson glides past the Catskills. In 1860, a flash flood uncovered the stumps of tree ferns of the Devonian Period, some 370 million years ago, near the little Catskill village of Gilboa. More trees were found in 1920. Evidently these trees were the remains of a forest that is still the oldest ever discovered.

The ancient forest seems to have consisted of a single kind of tree, *Aneurophyton*. It had a straight trunk 20 to 40 feet high, an onion-shaped base, and a crown of large, drooping, fernlike fronds.

Between Newburgh and Peekskill, the course of the Hudson winds through the imposing gorge that is known as the Hudson Highlands. The Precambrian rocks underlying this region are an ancient belt of once much higher mountains. Gneiss, schist, and marble are the

major rock types but a newer rock, Storm King granite, forms the crest of the highest ridges.

Leaving the Highlands behind near Peekskill, the waterway follows a course that separates the New England Uplands on the east from the New Jersey Lowlands on the west.

The bedrock of the New England, Uplands, which includes New York City represents remnants of a long-vanished mountain range that was created about 400 million years ago. The most important component of the bedrock is a mica schist which forms a firm foundation for Manhattan skyscrapers.

New York City—and particularly Manhattan Island—has attracted mineral collectors for over a century. More than 170 mineral varieties have been reported from Manhattan alone, a record exceeding that of any other area of comparable size.

On the opposite shore of the Hudson are the New Jersey Lowlands, which are composed mostly of sandstone and shales of the Late Triassic Epoch, about 195 million years ago. The most striking aspect of the Lowlands are the Palisades, a line of almost vertical cliffs. They were produced when molten rock, or magma, moved up along deep-reaching faults into the sandstones and shales of the surface.

The giant "columns" of the Palisades are a result of the cooling and subsequent contracting of the solidifying magma.

Here the geologic journey of the Hudson approaches its end. Soon the waters of the Hudson join with East River (also an estuary) to form Upper New York Bay, one of the world's most remarkable harbors.

Lady Waltonians Win $100.00

as reported by John Beck

NOT ONLY did the Platte Valley Chapter, Lady Waltonians, build a very fine float to win the $100.00 first prize in the Grand Island, Nebraska, "Harvest of Harmony" parade but they put their theme "America the Beautiful" before some 25,000 persons along the parade route.

Although this chapter is less than a year old it refused to be talked out of taking on participation in the parade in competition with older, larger organizations such as the Chamber of Commerce, Eagles and Lions Clubs. They went all out doing all the work themselves. They gathered materials, sawed lumber, drove nails, taped a long playing record of a fine soprano voice singing "America The Beautiful" and even passed out Anti-Litter bags along the parade route.

They did concede the privilege of driving the new green and gold John Deere tractor to a man and had two Boy Scouts carry the official IWLA banner ahead of the float.

A large borrowed flat-bed trailer was built up and out with a framework of gold and green and a back work of cedar, beautiful colored shrubs and bushes with red and yellow berries, all in their radiant fall colors, with song birds scattered through the branches. Then a waterfall down through rocks into a lake in the middle of a green bedding of grass and yellow leaves. By the side of the waterfall and ahead of the cedars was "Smokey, the Bear" with his spade and holding a sign "only you can prevent forest fires". Amidst the cat-tails and on the water of the lake were several wild ducks and a couple of bull-frogs. Grazing on the grass was a Canada Goose with a deer at the edge of the brush and trees. On one side, in long grass, was a sharp tailed grouse and a greater prairie chicken and in a clump of weeds was a cock pheasant. All together very symmetrical and well balanced outdoors.

On a sloping surface around the edge of the float were such signs as the "Platte Valley Chapter of the Izaak Walton League", "Keep America Beautiful", "Don't be a Litterbug", "Hunt Like A Gentleman", "Keep America's Waters Clean", these all telling a message of what the Ikes stand for.

Remarks heard from the crowd on the street, "Thanks for the "Litterbag", "Where did they get all the wildlife on that float", "How wonderful", What a Good Idea!" with much hand clapping and many "Ohs" and "Ahs". Twas a crowd pleaser!

After the parade, the gals dismantled the float, pulled all the nails and returned most of the lumber to the dealer and returned the mounted birds and animals to their owners. The expenses were very light and most of the cash went into this chapter's treasury besides putting the name and ideas of the Ikes before a great many people.

At the quarterly meeting of the Board of Directors of the Nebraska Division of the IWLA held at St. Michael, November 20, the Platte Valley Chapter was given a standing vote of appreciation by the officers, directors and committee members present, for a wonderful job well done.

Pennsylvania Hunter Program

THE PENNSYLVANIA Game Commission's Hunter Safety Program has been selected as the most outstanding in the nation, the International Association of Game, Fish and Conservation Commissioners announced at their annual meeting in Kansas City, Missouri.

Pennsylvania's program, initiated by the Game Commission in cooperation with the National Rifle Association in 1958, has trained 96,053 persons in the safe handling of firearms.

The Game Commission has certified 4,700 Hunter Safety Instructors since the beginning of the program eight years ago. The Instructors, representing sportsmen's clubs, schools and civic organizations, receive intensive training and must demonstrate their proficiency before being certified by District Game Protectors.

Included in the Hunter Safety Course is at least four hours of instruction in arms and ammunition, safe handling of firearms, including bow and arrow, responsibilities of hunters in identifying game, landowner-hunter relations, game laws and Pennsylvania's conservation history.

All students must successfully complete the course of instruction before receiving a certificate from the Game Commission.

The program is entirely voluntary on the part of instructors and students.

Hunter Safety Coordinator John C. Behel directs the statewide program.

Official Notice
45th Annual Convention The Izaak Walton League of America

THE 45TH ANNUAL Convention of The Izaak Walton League of America will be held in the Pfister Hotel, Milwaukee, Wis., July 12–13–14–15, 1967.

Nominations: In addition to nominations for National officers and National Directors made by the Nominating Committee. Accredited delegates in attendance may make nominations from the floor. National Officers; a President, five Vice Presidents, a Secretary and a Treasurer will be nominated and elected in accordance with the Articles of Incorporation and Bylaws of the League. National officers whose terms expire in 1967 are:

National President—Reynolds T. Harnsberger

National Secretary—James A. Thomas

National Treasurer—Del Lorice Olson

National Vice-Presidents—Roy Carlstrom, Claude B. Harris, Charles H. Kindred, Leroy E. Knott, Ries Tuttle

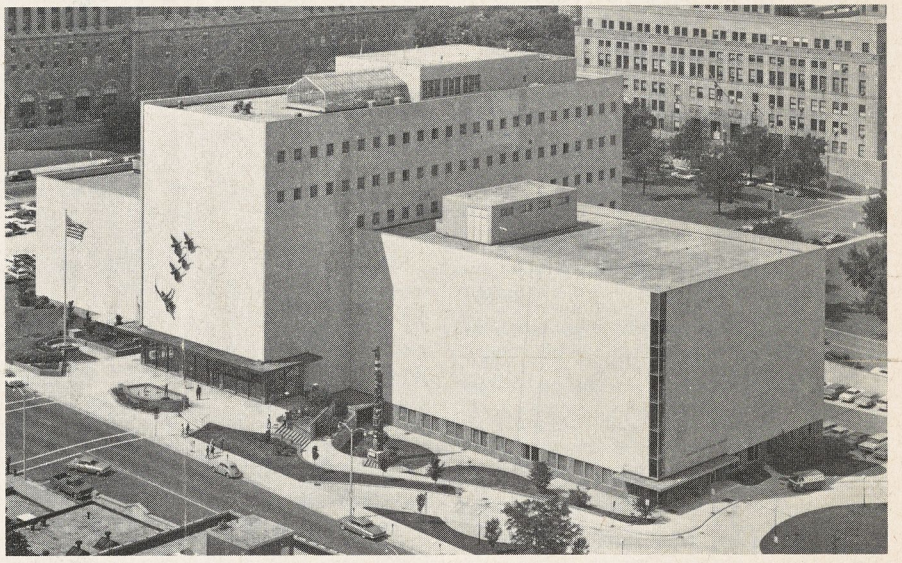
Endowment Annual Meeting: This is official notice of the Annual Meeting of The Izaak Walton League of America Endowment for the purpose of election of directors and other business to be held in the Pfister Hotel, Milwaukee, Wisconsin, July 13, 1967. The terms of Endowment Directors; Simon J. Sachs, Thomas E. Dustin and John Heddons expire in 1967.

Expiring Terms: Terms of all National Officers expire annually on August 31. Election of all National Officers and 25 Directors is at the National Convention. National Directors serve three years, effective with each National Convention and these 25 elected Directors assume office immediately.

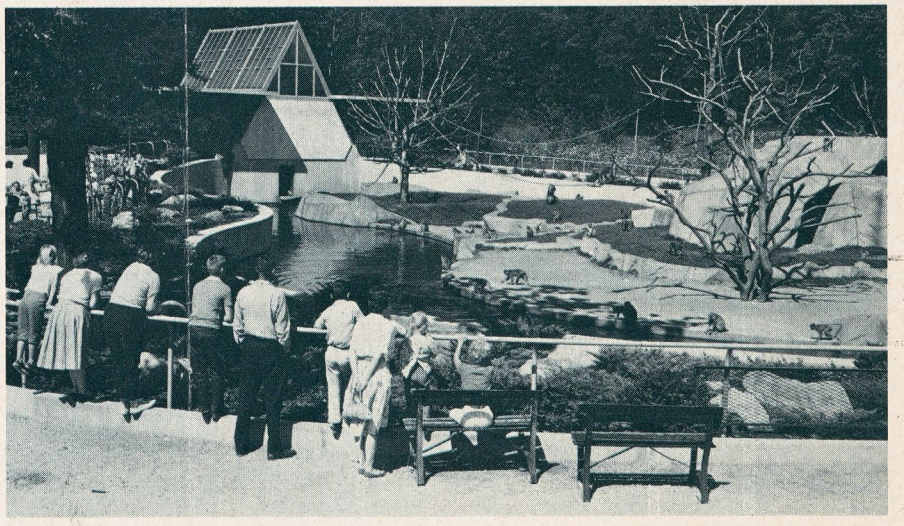
Directors whose terms expire with the 45th Annual Convention are:

Georgia: William W. Huber
Illinois: Martin F. O'Neill
Indiana: George L. Carey, W. K. Oliver, Sam Ropchan, H. J. Steiner
Iowa: Dr. M. A. Dalchow, Dr. Keith McNurlen, C. M. Naser, Richard G. Townsend
Maryland: Preston M. Stevens
Michigan: Joseph Karmann
Minnesota: George Rickert, Raymond A. Haik
Nebraska: James Westphal
New York: Morris W. Burke
Ohio: Gus E. Condo
Oregon: Judge Carl D. Etling
Pennsylvania: Harvey Adams
South Dakota: Loren Osborn, Merle G. Rossel
Virginia: Mrs. Sarah E. Hill
West Virginia: Ephe M. Olliver
Wisconsin: Bernard Cummings, Fred Stamm

What to see in Milwaukee—below: Milwaukee Public Museum. Milwaukee Public Museum photo.



Milwaukee Zoo. Wisconsin Conservation Department photo.



Milwaukee War Memorial and Art Center. Wisconsin Conservation Department photo.