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PAPERS OF THE MICHIGAN ACADEMY OF
SCIENCE ARTS AND LETTERS

EDITORS

EUGENE S. McCARTNEY
UNIVERSITY OF MICHIGAN

PETER OKKELBERG
UNIVERSITY OF MICHIGAN

VOLUME XVI

“Pusilla res mundus est nisi in illo quod quaerat omnis
mundus habeat.”

—SENECA, *Naturales Quaestiones*

Ann Arbor

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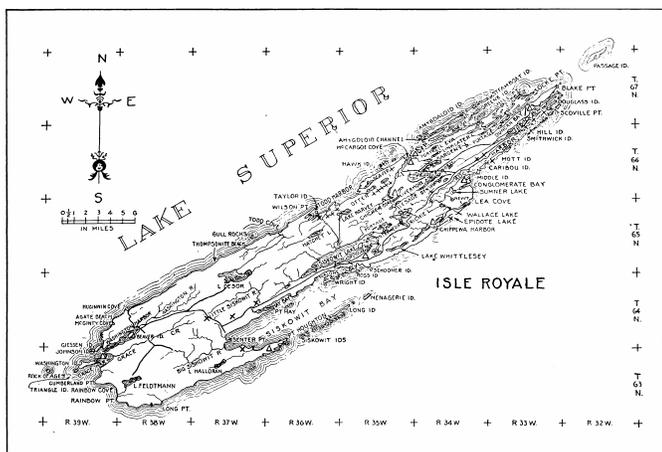
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A SUMMARY OF THE ARCHAEOLOGY OF ISLE ROYALE, MICHIGAN

FRED DUSTIN

INTRODUCTORY

THIS paper, which is an attempt to give a brief statement of the archaeology of a most interesting island (see Map 1), is based on the explorations, discoveries and studies of several scientists and laymen, among whom are Charles T. Jackson, Henry Oilman, N. H. Winchell, Alfred C. Lane, Wilbert B. Hinsdale, George R. Fox, William P. F. Ferguson, S. A. Barrett, George A. West and Carl E. Guthe. I have also made use of my own observations in the summers of 1929 and 1930, which were quite extensive in the northeastern half of the Isle but, owing to the exhaustion of the fund appropriate are incomplete, especially for the Washington Harbor region, the ridges from Hay Bay to the Island Mine, the vicinity of Lake Desor, Houghton Point and Long Point. To complete the survey would require not less than four weeks; it is hoped that means may be found to close these gaps.



MAP 1. Archaeological map of Isle Royale. Explanation of symbols: X, prehistoric mine; Δ, camp or village site; ---, trail. This map was drawn by W. B. Hinsdale's *Archaeological Atlas of Michigan* by Edward J. Stevens, from a rough draft made by the author.

[1. Archaeological map of Isle Royale]

Much that is fanciful has been published on Isle Royale; for instance, on January 18, 1931, there appeared in a syndicate of Michigan papers a headline, "White Men Sunk Shafts in 1840." The island was not ceded by the Chippewas until 1842. In the first paragraph the writer says that "Minong" means "the good place to get copper," but it means simply "island," or more specifically, "the island." Farther on he tells us that "competent scientists have figured industriously. To scar the rock as extensively as it has been scarred would require one thousand men working ten thousand years. The hammers are of a stone not found on Isle Royale. They were brought from a distant Minnesota shore." But these fantastic statements are overshadowed by others following; for instance, "Pits, hundreds of them, containing the almost powdered trunks of trees of eight

hundred and fifty growth rings revealed other evidences of the working of antiquity." We may well wonder how the growth rings of "almost powdered trunks" could be counted. Some years ago a section of a fallen pine was cut and about two hundred and fifty rings we counted, but not over "hundreds of pits."

When the imagination is allowed to run riot, figures lose their value and alleged facts must be greatly discounted. To the archaeologist, Isle Royale is a fascinating field which needs no resort to fable to deepen its interest.

PREHISTORIC COPPER MINES

Beginning at Washington Island, at the southwest end of Isle Royale, with its surrounding islands and rocks such as Triangle Island, we find native copper outcropping, and wherever the white miner has worked the Indian miner has worked before him. Along the north shore northeasterly from Washington Harbor the archaeologist has not explored to any extent until Todd Harbor is reached. Here, near the beautiful little falls that marks the entrance of Hatchet Creek into the harbor, and northeast along the ridges, there are still to be found several prehistoric works as left by the ancient miners, but others have disappeared through the labors of their white successors.

There are also indefinite reports of old pits near the shores of Lake Desor, and it seems probable that exploration would reveal them.

Continuing northeast we come to Hawk Island, and here, on the mainland of the Isle, considerable work was done by white miners in the late 'forties and early 'fifties of the last century, presumably on prehistoric locations. Passing McCargo Cove for the time being, we do not find much of interest until we round the head of the Isle and arrive at Scovill Point, called by the early explorers "The Fore-Finger," referring to the four points or "fingers" characterizing the northeast end.

Not far from the end of Scovill Point and thence southwest for five or six miles the rock was pitted in many places by the red miners, and some of their work may still be seen near the trail which runs southwest from the end of the point past Rock Harbor Lodge, where some years ago a mass of copper weighing thirty-five pounds was removed from beneath a slab of rock. On Minong Island, the location of Minong Lodge, which was built many years after all mining ceased, a very heavy piece of copper was extracted from the loosened rock while leveling was being done for the foundation.

At the old Siskowit Mine opposite Mott Island there may still be seen the shallow pits and the stone hammers of the primitive workmen. On Hill Island and Mott Island old diggings remain. In the early days lumps of copper were collected from the small beaches and even now the tourist picks up pebbles of prehnite and small masses of quartz mixed with other minerals, which show bright surfaces of copper here and there or small specks of that metal imbedded in the matrix, and we may know

that the Indian miner was not slow to collect in this way, for the very earliest accounts mention this "float copper" as a source of supply.

Passing southwest through the Middle Islands Passage at the Old Light and on to Chippewa Harbor, the voyager by boat will note many places along the shore where mining operations were carried on by whites, and the traveler along the ridge a little back from the water will see signs of prehistoric mining.

Beyond Chippewa Harbor there are comparatively few workings to be seen until the vicinity of Hay Bay is reached. A half-mile north of the outlet of Little Siskowit River at the falls. William P. F. Ferguson discovered some prehistoric mining pits on a rocky salient of an ancient lake beach, which from its general appearance led him to believe it to be a rudely constructed fort, but a study of remains shows the true character. Across the river to the southwest he observed many shallow pits which he thought were ancient pit-dwellings; there is evidence that they were simply holes dug by white miners testing for bedrock along the old beach.

About two miles southwest of the falls along the ridge Ferguson found other prehistoric pits which had been partly destroyed by mining, probably by workers at the Island Mine to the northwest. South of these pits I found and reported a large group, which were undisturbed, except for a short trench through a pile of waste rock and earth. A rough count gave the number as twenty-seven, but it is quite possible there were more, for my examination was cut short by approaching darkness.

From the site of the old county seat at the head of Siskowit Bay, running almost due northwest two miles, are the remains of a road built to the Island Mine, which operated in the 'seventies. The several shafts were located on old Indian pits, one or two of which may still be seen near the first shaft. Not far beyond the last shaft the earliest surveyors who made a record of their work found a clearing of an acre or more and full evidence of a primitive "sugar bush." A fine growth of hard maple extends along the ridge.

We shall now return to McCargo Cove, but instead of passing around the northeast end of the isle, will follow a different route. There are good reasons for believing that most of the ancient miners came to Isle Royale by way of the Keweenaw Peninsula, following the shore in their canoes from the vicinity of the present Portage Lake Canal to near Eagle Harbor, thence directly across to Bought on Point. With favorable weather it would not be difficult to traverse this distance between rising and setting suns, or, in summer, in a much shorter period.

Probably many voyagers would set their course directly for Chippewa Harbor, forty-five miles from Eagle Harbor, and only two or three miles farther from the nearest point on the peninsula than Houghton Point. Arriving at Chippewa Harbor, they would rest all night at the village site on the Narrows. From Chippewa Harbor there was a portage of about one and one-half miles to Lake

Richie, which was crossed to a half-mile carry to Lake Le Sage.

From the north shore of Le Sage, another portage of a half-mile to Lake Livermore, crossing which they would come to a very short carry to Chickenbone Lake, thence to the outlet with another short portage to the head of McCargo Cove.

Southwest of the upper end of McCargo Cove, and a mile distant, are the large open cuts, shafts and rock piles of the Minong Mine, which produced about one half of all the copper obtained by the white miners from Isle Royale, and here also the prehistoric workers operated for probably hundreds of years. The first primitive mine noted is about forty rods southwest of the old Minong Mine landing, marked by a few submerged logs still to be seen in the clear water near the head of the cove. From the first pit southwestward the workings increase in number to just beyond the Minong Mine, where they are so numerous that they overlap and run into each other; the worked-out pits were filled with the waste from adjoining ones. It is not improbable that there were two thousand or more of these tiny individual mines at this locality, since the workings extend half a mile beyond the Minong Mine to the southwest, although scattered excavations may be seen farther along the side of the ridge toward Todd Harbor.

The rock that bears the copper seems to be a brecciated conglomerate, but looks as though it had been cemented by heat instead of aqueous solutions. Some interesting minerals were noted on the great dumps of the Minong Mine, such as calcite crystals of several shades, masses of quartz crystals, manganese ore and curious incrustations of small red crystals said to be gypsum, also a small disintegrating rock mass containing numerous altered chlorastrolites.

There is a good trail from the Cove to the mine, but if one wishes to study the ancient workings he should not follow the path, but bear to the right at once, ascending the side of the ridge to an irregular terrace, where the first pit will be found; others farther on will lead to the north of the mine dumps and mine.

Visitors should not fail to ascend the cliff north of the largest open pit to Arthur's Lookout, where a grand panoramic view of island and lake is obtained. From this point, on the very crest of the ridge, one follows northeast for some distance, descending about fifty feet to the foot of a low ledge, where a small prehistoric mine may be seen which was noted on my last visit. With this exception the crest of the ridge seems to be barren of copper; the great deposits are on the south slope.

Large masses of the red metal were found in mining days; one had been uncovered by the Indian miners and projecting pieces broken off. It weighed over two tons, but the great nugget was far too massive to be of use to them, and later became the prize of their white successors. A picture of it from a photograph appears in W. B. Hinsdale's *Archaeological Atlas of Michigan*,¹ p. 25.

If the visitor has sufficient time and wishes to trace the copper outcrop to the southwest, he may follow the route of Dr. Adolph Murie and myself along the ridge, passing between Lake Harvey and Todd Harbor to the outlet of Hatchet Lake, distant about seven miles. The last half of the way is rough traveling, but views in the vicinity of Todd Harbor will well repay time and effort spent.

We may now mentally picture the Indian miner of long ago. We have seen him on his voyage across Superior and over the carries and through the lakes to Minong Mine. He has slowly and patiently hammered out a few pounds of the treasured metal and the summer is drawing to a close. A friend or perhaps a brother has been mining near the tip of The Fore-Finger and our red friend wishes to join him there. He loads his birch-bark canoe and paddles down to Birch Island near the foot of the Cove or to Indian Point just north. A "northeaster" has started to blow, raising too great a sea for him to venture forth on the great water; also the day is far advanced and the safer inside passage to be described later is feasible only in daylight, and so he camps for the night on grounds where for generations before him other ancient miners have built their fires. Here for a time we shall leave him.

TRAILS

In moving from place to place men and beasts naturally follow the lines of least resistance, whether having a definite objective or not. This is strikingly illustrated by the old trails on Isle Royale, and since there are no roads on this island the trails once trod by the Indian are now the highways of the white man and the moose, often well worn and leading by most direct routes to lake and cliff, to ancient mine and present-day camp or cabin. (See Map 1.)

Beginning opposite Minong Lodge on The Fore-Finger, a trail ran southwest, following the shore to the head of Rock Harbor, thence to Lake Richie, where it crossed the carry-trail from Chippewa Harbor; on to the outlet or Narrows of Wood Lake, thence to the shore opposite Malone Island, west to the outlet of Siskowit Lake, southwest to the falls of Little Siskowit River and on to the prehistoric mines near the old county seat. From this point it turned due northwest to the maple ridge and sugar bush, then two miles west to Washington Creek and down the ridge to Washington Harbor, near where the club house now stands. Across the head of the harbor another trail started, running to Haganon Cove and making an angle to the northeast; it followed the shore four miles or more.

There was also a trail that led from the old Indian village site at the Narrows of Chippewa Harbor to Lake Mason and farther to Lea Cove.

On Rock Harbor, at the outlet of Lake Benson and directly opposite an ancient camp site southwest of the Old Light, a trail began which extended west to McCargo Cove, crossing Sargent Lake at the Narrows. Half a mile west of the Narrows this trail was joined by one which

started at the head of Tobin Harbor and ascended the Greenstone Ridge to what is now called Mt. Franklin, where a magnificent view is obtained of lake, forest and islands.

From Mt. Franklin it followed the ridge southwest to a point where Sections 15, 16, 21 and 22, T. 66, R. 34, corner, and then bore west and south around Sargent Lake. From the section corners noted a branch trail continued a mile farther southwest, joining the trail to McCargo Cove near the head of Angleworm Lake.

During the summer of 1929 a member of a party that I accompanied to Mt. Franklin picked up a very fine copper knife on this trail just below the summit.

Two or three other short trails will be mentioned later.

VILLAGE AND CAMP SITES

Of village sites (see Map 1) there were none which were permanent in the same sense as those of lower Michigan. Isolation, climatic conditions and a possible lack of or difficulty in procuring food supplies in winter made it, even as it is now, a place of summer resort, but to the red man it was also a valuable source of treasured metal. At Washington Harbor, on the northeasterly extremity of Grace Island, a village existed, and it seems there was another one across the channel on the mainland of the Isle. At Fisherman's Home, which is situated on a little bay a mile southwest of the tip of Houghton Point, there was a village, and on the south shore of Siskowit Lake one-half mile southeast of Ryan Island a camp site has been reported.

On the south side of Rock Harbor and one-half mile southwest of the Old Light relics have been collected from a spot which the surveyors in 1847 observed was still a camping ground for Indians. At the Narrows in Duncan Bay there is a small shelf of land that nestles at the foot of the cliffs, where in 1927 a stone pipe was found. In 1929 I did a little digging at this place and uncovered an ancient firebed with its attendant remains of charcoal, bones and fire-cracked stones.

As might be expected, the most extensive village sites were at each end of the great highway to McCargo Cove. One located at the Narrows of Chippewa Harbor on about two acres of fairly level ground was examined with some care by the McDonald-Massee Expedition in 1928, by me in 1929, and by Dr. Carl E. Guthe of the University of Michigan in 1930. Good collections of potsherds, animal remains and artifacts of stone and copper were made by all.

At Birch Island near the mouth of McCargo Cove small collections were also made by them.

On Indian Point a short distance north of Birch Island, a village site was reported by me in 1929 and explored by Dr. Guthe in 1930, and some interesting discoveries were made. These three village sites are of great interest and serve as keys to unlock the story of how the prehistoric miners came to their great mining center near

the head of McCargo Cove, sojourned there and departed.

ARTIFACTS AND OTHER RELICS

The collections from Isle Royale are comparatively meager. Occasionally an arrow-point has been found, a stone celt or axe discovered, and at least two caches of copper implements have been obtained, but, in general, articles formed by the human hand are scarce.

There is one class of relic, however, of which hundreds may be collected, but only rarely do they show any indications of having been "manufactured." I refer, of course, to the stone hammers used in beating out the copper from the rock (see Pls. I-II). These hammers were simply boulders, natural masses of rock rounded and smoothed by wave action, many of them transported to the Isle by the great ice-sheet, distributed on old lake beaches high above the present lake level and left undisturbed for ages until the red miner came and made ample use of them. Of the hundreds I have seen only two were slightly grooved, and one of these was for domestic use. These hammers plainly show the uses to which they have been put, one end invariably being battered or spalled; sometimes both were. A few are of native rocks which have undergone the grinding and polishing process on their own beaches, but hard, tough stone like granite or syenite from the Canadian mainland predominates..

In the newspaper article noted in the introduction it was stated that these stone hammers were brought from Minnesota. Others have said they were systematically conveyed from the Canada shore, a striking contrast between fact and fiction.

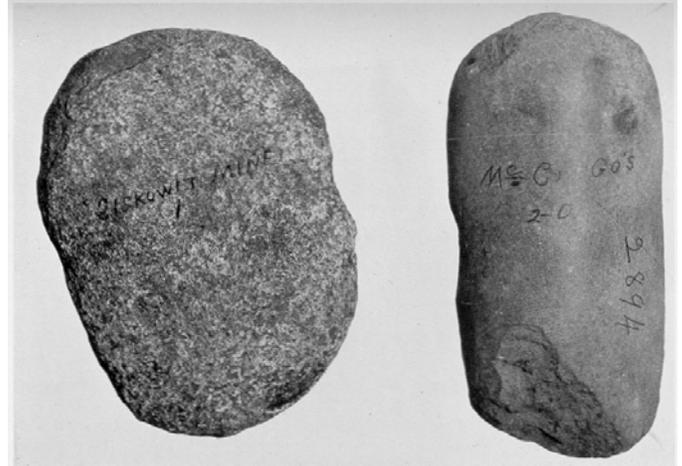
I have seen an undisturbed pile of these used hammers covered with lichens, which are of rather slow growth. Perhaps they have remained in their present situation for several centuries. Any estimates of time are mere guesses, but it may be safe to say that these mines were worked hundreds of years before Columbus sailed away to the west.

In studying the trails I have been impressed by a thing of considerable significance, namely, the finding of relics on them far from camp sites or termini. One is sometimes asked, "How do you know that a trail existed as you describe it?" A very reasonable question.

When the Government surveyors made the linear survey, they were required to enter on their field notes all trails crossed, with their distances from established marks, their bearings and other data. They were required to note village sites and other evidences of previous occupation. In addition to this, early explorers found these trails very convenient highways and used them frequently. The ethnologist also knows that the American Indian had certain characteristics which give the trained mind valuable clues. He knows that the Indian sought out and discovered points of vantage from which he had unobstructed views. He did this for two

reasons: he was an ardent lover of nature and realized that he was a part of it; also his caution and natural desire to locate his position were strong factors in his seeking heights. It was, therefore, no surprise to me when my friend found the copper knife on the trail to Mt. Franklin, for we were following the path that the Indian naturally took to attain the summit. I picked up a crude grooved implement on the Rock Harbor Trail not far from the Siskowit Mine. In 1928 an arrow-point was collected on the trail midway between the head of Rock Harbor and Lake Richie. Some years ago John Linklater found on the Sargent Lake Trail a fine knife made from white chert.

PLATE I



Two grooved hammers, much reduced in size, of a type very rare on Isle Royale; now in the University of Michigan Museums. Collected by the author

PLATE II



Stone hammers, much reduced in size, typical of those used by prehistoric Indian miners; now in the University of Michigan Museums. Collected by the author

The finding of these articles is only added testimony as to the location of these primitive highways, and proof of the passage of men to and fro.

COPPER IMPLEMENTS

Two caches of copper artifacts have been reported, one from a rock shelter on the west side of the neck of water connecting Wood Lake with Siskowit Lake and another at the Minong Mine at McCargo Cove.

Two small copper knives were secured by Dr. Guthe in 1930 from the village site at Chippewa Harbor, and one or two other copper articles have been mentioned from the same place. Others have been secured at Birch Island.

POTTERY

The question "Who were the ancient miners?" has been an interesting one, and some rather grotesque theories have been advanced, such as Aztecs from Mexico, Indian slaves of southern Indians, or supposedly civilized mound-builders of Ohio. The mysterious and improbable seems to have a stronger hold on the minds of many people than the obvious and natural. In science, at least, sane common sense is useful, and if we make use of previous observations it often happens that theorizing is unnecessary; it would appear that the query about the old miners is answered, at least in part, by the remains they have left.

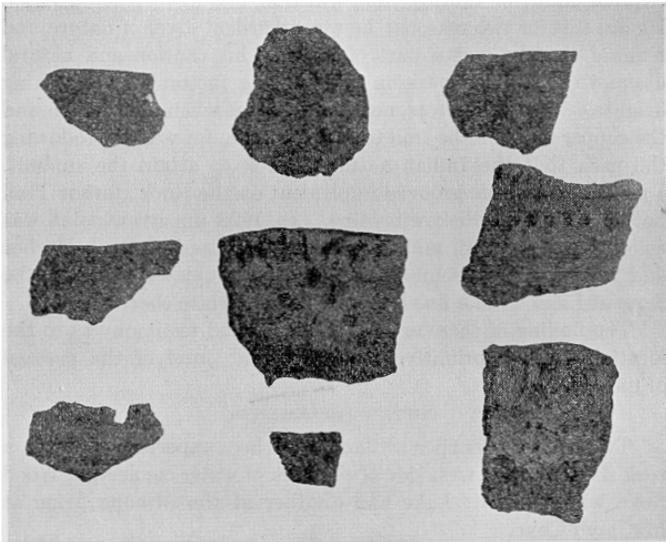


FIG. 1. Pottery sherds from Chippewa Harbor village site; now in the University of Michigan Museums. Collected by the author

Archaeologists have agreed that pottery is a fairly good key to the different cultures characterizing the several linguistic stocks, for there are certain unmistakable "hall marks" which are Algonquian or Iroquoian, for example. For these reasons some of us have collected these fragmentary remains with eager interest. The McDonald-Masse Expedition obtained about fifty potsherds in 1928, Dr. Guthe nearly a half-peck in 1930,

half coming from Indian Point and most of the others from Chippewa Harbor. In 1929 I collected over sixty pieces, all from Chippewa Harbor (see Fig. 1).

A study of these collections would indicate that nearly all the pottery collected was purely Algonquian, with a very few pieces of Iroquoian culture.

In my manuscript report of the preliminary archaeological survey made in 1929 for the University of Michigan, I endeavored to trace the course of the prehistoric miners on their journeys to and from the Isle. My conclusions were that the copper was mined by the ancestors of Indians still living; that they were of the same cultural condition as those shrewd redskins who told the Jesuit fathers that this wonderful island alternately appeared and disappeared; who related its awful dangers or mysterious phenomena.

Their stories had some foundation in fact. A few weeks spent on Isle Royale will convince even an incredulous person that in the strange "tides," the mirage, the awe-inspiring rocks, the wild forests and deep cold waters there is something that reaches to the depths of a thinking man's being. It teaches a lesson of the marvel and majesty that appealed to the ancient miner even more than it does to us.

HUMAN REMAINS

In 1908 the children of E. T. Seglem discovered a sort of cave not far from Fisherman's Home on Houghton Point. It was partly closed by rough stones, the removal of which revealed a quantity of human bones. On examination it appeared that at least thirteen persons were represented by these osseous relics. What happened to those ancient voyagers is a matter of interesting speculation, but of course must remain unknown. The skulls were identified by competent authority as Indian. So far as is known these are the only prehistoric skeletal remains that have been found on the Isle.

GEOGRAPHY

Isle Royale presents a series of ridges running from northeast to southwest, with deep valleys between. Except at the southwest corner beginning at Houghton Point and Siskowit Bay, where a hard sandstone is the prevailing stone, the island is a great upheaval of lava-formed rock, precipitous on the northerly side but more gently sloping southward.

The drainage in general follows the lines of the ridges, except the break beginning at Chippewa Harbor and ending at McCargo Cove, which has been described as a fault by some geologists.

There are more than fifty inland lakes of which the largest, Siskowit, is about seven miles long by nearly two miles wide. Most of these lakes are long and narrow, but a few are of odd form, for example, Chickenbone, Anglemorm and one or two others; their peculiar outlines

give them their names. Most of the lakes are of considerable depth; Siskowit has one sounding of 142 feet, and a tiny lake into which Lake Whittlesey drains is 22 feet deep.

There are scores of surrounding islands, especially around the northeast half, with deep narrow harbors and channels much like those of Maine and Norway. These, in connection with the long fingers, have formed sheltered passages to be further described.

CONCLUSION

Let us return to our Indian miner in camp on Birch Island. The berries of the mountain ash are red and the early frosts are dyeing the leaves with autumnal tints. Far out beyond the reef that marks the entrance to the Cove, he sees the white waves rolling high; he knows that his frail canoe cannot breast them. He cannot even venture into Amygdaloid Channel, for there, too, the northeast gale has full sweep. But there is a safe passage, so that at early morn we see him in his laden canoe paddling into a little bay northeast of the Cove, where by a portage of only a few rods he finds a sheltered passage through Pickerel Cove, thence to Lane Cove, from which by another very short portage he passes to Stockly Bay, and has some difficulty for a mile, for here there is a little exposure to the wind. Another troublesome but not long carry sees him in Duncan Bay, down which he paddles a mile and a half to the Narrows, where he lands at the little camp site. Beyond, the heavy seas, dead ahead, forbid farther progress, so here he must stay unless he makes the hard portage of a mile over the Greenstone Ridge to Tobin Harbor. The latter alternative is chosen. In due time he launches his canoe in Tobin Harbor opposite Minong Island and proceeds southwest to a trail running to Monument Rock, for he cannot pass this weird and awe-inspiring formation without paying his respects to its supposed powers. Had he time, he would follow this trail to the cliffs now called Lookout Louise, where a grand scene lies before the observer.

He returns to his canoe and paddles up the harbor to a neck of land where now stands Rock Harbor Lodge. Another portage and he enters Rock Harbor. That night he camps near the Old Light where now the fishermen's cabins stand, protected by the Great Indian Head, its features formed in rock, the subject of legend, story and poem.

The gale does not blow out for another day, but as it dies down he starts again on his voyage, for he well knows that soon a stiff breeze may spring up from the southwest. We see him following the shore to Wright Island, from there, the wind still favoring, he makes the long push to Houghton Point, where at Fisherman's Home we will leave him for the time being. The friend he had expected to meet on The Fore-Finger has secured his share of copper, but his food has run low, and so he has gone to the favorite grounds of the moose, Lake Richie, carrying over the two miles of trail from the head of Rock Harbor. A moose calf soon falls before his flint-

tipped arrow, and after a day spent on the shores of Richie, he paddles to its western extremity, from whence he portages to Intermediate Lake, distant a short half-mile. In that far-off day Siskowit Lake waters were several feet higher than at present, and Intermediate Lake, like Wood Lake, was connected with Siskowit by a channel of dead water, so that our Indian paddles on to the outlet of the latter, where a half-mile carry brings him to the shore of the great water. From this place he follows the same course to Houghton Point by way of Wright Island, over which his friend has passed, and at Fisherman's Home finds him waiting.

They have not voyaged alone, but wife, son or brother has accompanied them. They now await a fair day to cross the forty miles to Keweenaw. It comes, and we see their barks speeding over the waters until lost in the distance.

Thus we part with our red miners. They have left behind them their works but have taken with them their product. In years to come the white man will marvel at their labors, and as he picks up a copper spear on the fields of Michigan will speculate as to its origin and endeavor to trace it to its source.

SAGINAW, MICHIGAN

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THE WEAPONS OF THE ASAHAN BATAKS

CARL D. LA RUE

ONE who travels beyond the immediate path of the tourist in the East Indies is at once struck with the universal habit of the natives of carrying weapons. At first one feels some apprehension at being asked to lead the way down a jungle path with a dusky native treading almost on one's very heels and swinging the naked blade of a murderous knife. But after a time a measure of confidence comes, and one forgets that the knife is there, or better, realizes that the knife is not for him, but for the jungle, which must be fought back from the paths daily and hourly if they are to be maintained in a passable condition. As the native walks along he lops off overhanging branch and uprising shoot, so that every few steps the knife is brought into play. Should one desire a piece of wood from the trunk of a tree the knife is used; if a plant must be dug up the knife serves as a spade; and in a multitude of ways the knife is employed and appears the most useful implement which the jungle man has in his possession.

One soon realizes that there are a number of other types of knives in addition to the big one which the native may carry, or use about his dwelling. Some of these are worn mainly for display, though on occasion they may be wielded with deadly effect in a brawl. Some are for ceremonial purposes only, and still others are employed in household tasks or in making carvings of a delicacy seemingly impossible with such crude tools.

MATERIALS OF CONSTRUCTION

The Asahan Bataks are a little-studied and nearly extinct tribe of the East Coast country of Sumatra, where the author came into more or less close contact with them over a period of three years. During this time a collection of their weapons was assembled, a task by no means easy because the small number of members of the tribe meant that there were not many weapons to be had. Also, the waning of the tribal spirit before the inroads of civilization and the general poverty of these people had led them to sell or trade the typical tribal weapons for other goods, or for more common knives used by the Malay or the Javanese dwellers of the region. During a part of his sojourn in Sumatra the writer had in his laboratory a *krani*, or "helper," who was by birth an Asahan and who had been trained as a *guru*, or "teacher," in his tribe. This man, Ramit, alias Limah Bidin Sirait Holboeng, not only knew what were the traditional weapons of his people but was able to secure them for the writer from friends or relatives in distant villages. Many of the knives, which constitute the most common weapons, are very old and had long lain unused about the houses. Because of the age of the knives, and probably also because of the fact that the handsome and ornate weapons had been sold as the pinch of poverty had been felt, the collection has no great claim to beauty. The tribe has little contact with the tourist and its members have not had the stimulus to make new copies of their weapons for sale, as the neighboring Toba and Karo peoples have done. In general, the people have not even realized that the weapons had a sale value, and indeed most of them would not tempt anyone as curios, but one can only be glad for this, since it has made possible a collection which would otherwise not have been gathered.

It is doubtful whether so full a collection of the weapons of this particular tribe exists elsewhere, because most of the planters, who make up nearly all the European component of the population, have not recognized the fact that these people are not Malays. Usually, when the Bataks have been converted to Mohammedanism, as most of them have, they call themselves Malays. These people have passed as Malays and until quite recently no one has been interested in a special study of their manners, customs, utensils and other things. It is not likely that enough of the old weapons exist to make up another representative collection. This fact supplies a motive for this paper by one who makes no claim to the status of an anthropologist.

The weapons of the natives of North Sumatra have been treated at some length by Volz (2) in his work on that territory. Volz, however, did not come into contact with the Asahans and though he does give attention to the Toba Bataks, from which tribe the Asahan Bataks are probably derived, there are many names used for knives by the Asahans which are not recorded by Volz, if indeed they are used by the Tobas at all. Therefore, it is not possible to find the Toba counterparts of all the Asahan knives, but comparisons will be made wherever our limited knowledge renders this possible.

The blades of the knives and spears are of native steel, which is made by laying down layers of iron and charcoal and then forging the laminae together. In some blades the result is very good, though rarely as good as the work of the Achinese, who are extremely skilful workers of steel. In other blades the result is poor and the blade is soft, or the laminae tend to separate from one another. However, the greater part of the weapons are sufficiently well tempered to make the weapons formidable. The hilts are usually of hard woods, which are very strong and durable, although the wood may check considerably with age. Since they have been kept in the drier climate of Michigan most of the wood hilts have checked quite badly. The woods of the hilts are usually fine in appearance and in some of them rare woods are used, such as the *kayu kamuning*, which is much prized by the Malays.

Another material which is employed extensively is horn, usually that of the caribou or water buffalo. As will be noted later, the use of this substance has been supposed to influence the shape of the hilts of certain knives, though the writer is inclined to discount this influence. Two other materials of animal origin are often used, namely, bone and ivory. Bone is not seen on many of the weapons and seems to be placed only on the smaller knives. Ivory likewise is not used on the larger knives, but is rather common on the smaller ones.

The blades are forced tightly into the hilts and cemented in place by gambier or some other gum. The hilts may be provided with ferrules of metal, which in the Asahan weapons is usually silver. For some reason the Asahans rarely make use of copper, which is seen on so many of the knives and swords of the Karo Bataks. Ferrules of bone and of buffalo horn are frequently encountered, but many knives have no ferrule, although one may be suggested by a ring carved in the substance of the hilt.

The hilts are usually ornamented with carving, which is often an integral part of the design. The carving is particularly well developed in many of the bird and dragon head designs. In addition to the carving, silver bands or plates may be applied at the end of the hilt or elsewhere.

The sheaths are sometimes only temporary affairs made of soft wood bound together with pieces of rattan or palm fiber, but many weapons show as much care in the construction and ornamentation of the sheath as in the making of the hilt. The simplest types of sheath are made of two pieces of wood so shaped that, when they are put together, a place is left between them into which the blade can be thrust. The sheaths which reveal skill and patience in their construction are usually made of four parts, an upper ferrule or top piece, two side plates, and a lower ferrule or end piece. The upper ferrule is made of a solid piece of material and is pierced to allow the blade to pass through. On the lower side it is mortised to permit tenons from the side plates to be

inserted. The side plates are hollowed on the inside, so that a channel for the blade is formed when they are fitted together. Sometimes a single piece of wood is used in place of the two side plates and then the wood must be pierced from end to end for the blade. The side plates, or the single piece, must be provided with tenons at either end to fit into mortises in the ferrules. The lower ferrule is not pierced, but has a mortise cut in it above for the tenons of the side plates. The four pieces are often shaped and fitted with considerable skill and the sheath is quite worthy of the weapon which it guards. The finer sheaths are most common on the smaller knives, such as the *toembuk lada*, which are carried tucked into the belt, waistband or top of the *sarong*, which is a kind of skirt worn by all well-dressed Malays and Bataks. The larger weapons are frequently carried without the sheath, or are guarded by loose-fitting sheaths of soft wood on which little effort is wasted. These are always made of two parts only, so far as Asahan weapons are concerned. Among the Tobas and the Karos one sees many large knives with sheaths beautifully made and richly ornamented. These are of two parts, but may have a lower ferrule of copper or silver, although the upper ferrule is almost always lacking. Bands of copper or silver are very common on such sheaths.

The sheaths of Asahan knives are usually made of wood, even though the hilt may be of other substance, but entire sheaths of horn are not uncommon. In many examples the three upper parts are of wood and the lower ferrule is of bone or horn. If the bone or horn is hollow, the opening is usually closed by a plug of the same material or of wood. Nicely wrought bands of rattan or palm fiber are used to hold the side pieces together and the tenons are cemented into the mortises with gum. Bands of silver wire are common, but some specimens have wide bands of silver, which may cover nearly all the side plates. The lower ferrules may show shapes in keeping with the general design, but are rarely much carved. The upper ferrules reveal various designs, more or less in harmony with the hilt designs, as will be noted later. These may be elaborately carved.

TYPES OF KNIVES

Volz (2, Vol. 1) divides Batak knives into two classes: those with hilts bent backward away from the edge of the blade, and those with hilts bent toward the blade. The first class is said by Volz to be rare in Sumatra and this is surely true among the Asahan people. Only two types of knives, the *raut* and the *tordjong*, show this inclination of the hilt.

Knives with backward-bent hilt

Raut. — The *raut*, or *rawit*, as it may be spelled, is a small service knife used in and around the house. It occurs in Tobaland and is of similar use there, according to Warneck (3). Volz figures a *raut* from northwest

Karoland and three *rawits*, one from Upper-Kwalu and two from Habinsaran. There appears to be no good reason for one spelling rather than the other, and Volz uses both on one plate (Vol. 1, Pl. 102). Volz's classification breaks down here, since three of the *rauts* he figures have backward-bent hilts whereas the other one has a forward-bent hilt.

The *raut* is a thin-bladed knife, with a back which is straight or nearly straight, having only a slight bend backward. The blade is cut down at the base so as to leave a narrow flat tang on which the hilt is fixed.

Two specimens of the *raut* are included in the author's collection. No. 1 (Pl. V) is a very small knife with a blade 10 cm. long, 12 mm. wide and 4 mm. wide at the back. The tang is 1 cm. wide and 7 mm. long, and the hilt of round bone is 7 cm. long. It is carved with a dragon's head and has only a false ferrule shaped in the bone.

No. 2 is a larger knife, with a blade 16 cm. long, 2.2 cm. wide and only 2 mm. thick. The tang is 1.3 cm. long and 1 cm. wide just back of the blade, but tapers to 7 mm. where it enters the hilt. The hilt is of hard wood and widens out at the end to a sort of six-pointed rosette, called *boenga kiambang*. The hilt is 9.3 cm. long and the ferrule of bone is 8 mm. wide.

Although No. 1 has no sheath, No. 2 has a two-piece sheath of soft wood bound by a single hand of three strands of rattan. There is no carving on the sheath, but it is shaped at the upper end into a three-pointed figure.

Tordjong. — This is the second type of knife with backward-bent hilt. Volz speaks of this weapon as a *tordjong*, but does not describe it, except to say that it has a backward-bent hilt.

Two examples exist in this collection. No. 3 is an old weapon that shows many laminae. The blade is 23.5 cm. long, 2.3 cm. wide at its greatest width, which is just back of the point, and has a thickness at the back which tapers evenly from 8 mm. at the base to 2 mm. near the tip. The tang, which is round, 1.3 cm. in diameter and 3 cm. long, has a rather fine ornamentation beaten into the steel. The hilt is made of black horn, bent sharply backward from the edge of the blade, and is 14 cm. long, the length being measured along the curve. Two bands of silver, each 2.5 cm. wide, ornament the hilt. These bands are without carving, except that the lower one is scalloped at the upper edge. The ferrule is of copper, which is rarely used by the Asahan Bataks, though, as has been mentioned, this metal is much favored by the Karos. The sheath is made of two pieces of soft wood and is almost entirely covered with two bands of silver, one narrow and the other wide.

No. 4 is a very graceful *tordjong*, with fine sweeping curves from point of blade to base of hilt. It is lighter and in every way finer than No. 3. The dimensions of the blade are: length, 16.5 cm.; greatest width (near the tip), 1.9 cm.; thickness of back, an even taper from 3 mm. at the base to 1 mm. near the tip. The tang is 1.6 cm. long

and 4 mm. thick. It is wider (1 cm.) at the hilt than at the base of the blade (8 mm.). The base of the blade has a short guard in the shape of a prong about 1 mm. long. The hilt is of black buffalo horn and widens from a diameter of 1.3 cm. at the ferrule to one of 3.7 cm. at the end. The outer end terminates in a six-pointed *boenga kiambang*, with a steel prong protruding from it. The hilt proper is 10 cm. long and the prong is 3.3 cm. long. The outer end of the hilt is incased in silver beaten around the points of the *boenga kiambang* and there is a handsome silver ferrule 2 cm. wide. (See Volz 2, Vol. 2. Fig. 107.)

The hilts of both Nos. 3 and 4 are called *kapala hinata*. *Kapala* means "head" and is a general term for a knife hilt. What *hinata* means the author has been unable to discover. It is not given in Warneck's Toba vocabulary (3). Presumably, both hilts are of the same type, but one has a pointed horn. The other is not pointed at all unless the steel prong is intended to carry out the idea, as it does in a fashion. What other purpose the prong may have is uncertain; possibly it has a magical significance, but one must be chary of assuming this. Some persons explain every doubtful thing in such a fashion although the truth, if known, may show the idea to be grotesque. It seems strange that the name *boenga kiambang* ("*kiambang* flower"), which is applied to the hilt of No. 2, is not given to that of No. 4, for the shape is the same except for the prong. Evidently the prong carries out the idea of the long pointed tip, so that the hilt becomes a *hinata*.

The sheath of No. 4 is of two pieces of hard wood bound by a wide (6 cm.) silver band much battered and broken at the top. The top of the sheath is shaped to a three-pointed figure. A band of two strands of rattan binds the top of the sheath. This appears to be a recent addition put on to protect the sheath from a split which has appeared at the top.

It appears to the author that the *hinata* hilt is related to the *rendjong* of the Achinese. Nos. 5 and 6 are examples in the author's collection, but they are Achinese. So far as could be determined, this weapon does not occur among the Asahan Bataks. Volz considers the *tordjong* a form of the *rendjong*. To the writer, the blades of the two knives do not offer the same resemblance as do the hilts. The hilt of No. 3 is surely much like those of Nos. 5 and 6. The *rendjong*, besides being one of the most murderous fighting weapons, which it is a penal offense to carry in Sumatra, seems to have a wide use as an *adat* or "ceremonial knife." The elaborate ornamentation of Nos. 3 and 4 on both hilt and sheath suggests a ceremonial or display function. The *tordjong* is not to be compared with the *rendjong* as a fighting blade. It is awkward rather than otherwise, whereas the *rendjong* is a model of efficiency for its purpose. It is doubtful whether there is a more diabolical knife in existence. Its hilt gives a wonderful grip and its thin razor-edge blade can be driven with a peculiar backward stroke of tremendous force. With its lifting

thrust, a proficient fighter can cut through the entire viscera of a man from lower abdomen to throat in a single stroke. No one can imagine such a feat being performed with a *tordjong*.

Knives with forward-bent hilt

Most of the Asahan knives have hilts of this type. The different forms included here are the *badik*, the *bolado*, the *golok*, the *goepuk*, the *toembuk lada*, the *halasan*, the *hangan*, the *simoenoeng*, the *alamang* and the *koerambit*.

Badik. — This is generally a small knife used mostly in the same way as a jackknife is used by us. The blade is straight and thin, with both back and edge usually ground down to form the point.

No. 7 is a very old weapon in which the laminae are conspicuous. Apparently, a small amount of silver has been placed between the laminae. The blade is 18 cm. long and retains a width of 1.6 cm. from the hilt out to within 3 cm. of the tip, where both back and edge begin to curve to form a point. The thickness is 2 mm. There is no tang visible in this or any of the other *badiks*; the blade keeps its full width up to the hilt. The hilt is beautifully shaped of black buffalo horn and is 9 cm. long. It is curved and flattened and has an ornamental false ferrule carved in the single piece of horn. The sheath is of two pieces of buffalo horn, with an end piece of hard brown wood, which is pointed and set into V-shaped cuts in the two horn side pieces. This type of end piece is not seen in any other specimen in the collection. The sheath is bound with two braided bands of rattan. No. 8 is very similar to No. 7 in shape, but the tip is slightly different, since the back tapers to the point in a straight line instead of in a curve, as in No. 7. The blade is laminated without silver and is almost identical in size with No. 7. The hilt is much like that of No. 7, but is inferior in design. The curves are not so good and the false ferrule is less ornamental. This hilt is made of a hard brown wood, and the side pieces of the sheath are of a hard reddish brown wood. The end piece is of bone, which is hollow. The side pieces extend as tenons into the hollow, thus forming a plug at the end. The upper end of the sheath is ornamented with a graceful leaf carving. The sheath is bound with six silver bands set in two groups. Each band is made of two strands of wire.

No. 9 is a gem of knife construction. The blade is 10 cm. long, 1.5 cm. wide and 1 mm. thick. The back is straight throughout its length and the point is formed by the upward curve of the edge. The hilt is 5 cm. long and is made of the rare and beautiful *kamoening* (*Murraya sp.*) wood finely carved. The sheath is also of *kamoening* wood and is made in four pieces, as are only the finest sheaths. The joining and carving are very fine. This handsome little knife was the property of a small Asahan girl.

No. 10 is a doubtful specimen. The blade is *badik* in shape, but differs from the type in its larger size, 25 cm. long by 2.3 cm. wide, and by its thick back, 9 mm. at the base and tapering to 1 mm. at the tip. The hilt is of hard, dark red wood and is finely carved in a peculiar design which will be discussed later. It is 11.5 cm. long. There is a false ferrule, rudely carved as compared with the rest of the hilt, which suggests that there was once a ferrule of other substance which covered it. The sheath is of two pieces of hard red wood carved in a leaf design at the upper end. It is bound by a single band of braided rattan.

No reference to the *badik* is found in Volz, nor does Warneck give the word in his vocabulary, but it is hardly likely that a type so common as this in one tribe can be unknown to related tribes.

Bolado. — This is another small knife which is much used by the Asahans. It is rather difficult to distinguish the *bolado* from the *toembuk lada*, which will be discussed next. It seems that the blade of the *bolado* is a little lighter than that of the *toembuk lada*, that it is slightly less curved, and that the point is longer than that of the latter. Also the *bolado* usually has at the base of the blade a little guard which is absent from the *toembuk lada*.

No. 11 is a very handsome knife, and blade, hilt and sheath are all beautifully finished, though there is no elaborate carving. The blade is 18 cm. long, 1.9 cm. wide at its base and 7 mm. thick at the base. There are two deep, longitudinal grooves parallel to the back in each side of the blade. The tang, which is round, is 1.8 cm. long and 1.2 cm. in diameter. The hilt is of a very hard black wood and is 6.5 cm. long. The sheath is made in three pieces. There is no end piece, but the side pieces are hollowed out and fitted together to make a closed sheath. The top piece is of black wood like that of the hilt, but the side pieces are of a red wood. Two braided rattan bands encircle the sheath near its middle, and a silver band 2.5 cm. wide is fitted just below the top piece. This band is ornamented with a floral design in relief.

No. 12 is much like No. 11, but is not so well made. The blade is 16.4 cm. long, 1.8 cm. wide at the base and 6 mm. thick at the base. There is only one longitudinal groove on each side of the blade. The tang is heavier than that in No. 11, but of the same length. The hilt is 5 cm. long and is made of a rather soft wood. This knife has no sheath.

No. 13 is a small, but very strong knife. It is possible that it was once much larger and that it has been worn down to its present size by long use. The heavy base and the general appearance of age give weight to this supposition. The longitudinal grooves on the sides of the blade are very shallow and the guard at the base of the blade is nearly gone. The blade is 10.9 cm. long, 2 cm. wide at the base and 7 mm. thick at the base. The tang is 1.6 cm. long and heavier than that of either No.

11 or No. 12. The hilt is 5 cm. long and is made of ivory which has turned brown from age. The sheath is a simple two-piece affair made of soft wood. It is bound by one braided rattan band and is stained with betel juice, or possibly with the dye from teak leaves.

It may be that the *bolado* is only a local variation of the *toembuk lada*, since no reference to its use elsewhere has been found.

Toembuk lada. — This is the most widely used dagger in Sumatra, since it is a favorite weapon with the Malays as well as with many of the Batak tribes. Its resemblance to the *bolado* has already been noted. Volz believes that the *toembuk lada* has been derived from the Achinese *rendjong*, as has the *tordjong* also, according to his idea. The blades are not dissimilar, though the *rendjong* has a thinner blade. The hilt form is entirely different and the method of use, which is determined by the shape of the hilt, is also very different. The stroke of the *toembuk lada* is made downward and is so aimed that the blade passes back of the clavicle and down to the heart. It is more difficult to make the proper stroke with the *toembuk lada* than to give the disemboweling stroke of the *rendjong*, but the hilt of the *toembuk lada* does not admit of the latter stroke. There is no question, however, that the *toembuk lada* is a formidable weapon.

No. 14 is the most beautiful knife which the writer has ever seen. From every point of view blade, hilt and sheath show graceful curves, fine workmanship and beautiful ornamentation. The blade is 18 cm. long, 2 cm. wide at the base and 1 cm. thick at the base. It is finely made, with only very thin laminations showing. The shape is exceedingly good, with flowing curves and fine balance. On each side of the blade there are two deep grooves, which do not run exactly parallel to the back, but follow a course harmonious with the design of the blade. The tang is 1.1 cm. long and 1 cm. in diameter in its thickest part next to the hilt.

The hilt and the sheath are both superbly shaped from black buffalo horn. The length of the hilt is 6.5 cm.; like so many of these knives it is small for our hands, but it must be remembered that the hands of the people who use these knives are small, so that these hilts are adequate for their users. The end of the hilt is carved with a conventional representation of the *boenga hoenik* ("*hoenik* flower"). Bartlett (1) identifies this plant as *Curcuma zedoaria* Rose. The flower appears to come out of a conventionalized dragon's mouth and all the details of the connection between the flower and the dragon's mouth are worked out in a masterpiece of design.

The sheath is made in four pieces. The two side pieces are unornamented, being merely curved to harmonize with the general design, but the end piece is both ornamented and curved. End piece and side pieces are cut lengthwise of the grain of the horn, but the top piece is made with the grain running crosswise. This piece is the finest carving which the writer has seen in any East

Indian work. The solid block of horn has been pierced to allow the passage of the blade and mortised to admit the tenons on the side pieces, no mean task in itself. Then the piece was shaped to the general design of a top piece, but with the most beautiful curves in every part. Finally, the back of the top piece was carved in a complex of interlacing leaves of wonderful delicacy. The intricacy of the design is remarkable when one considers the crudity of much native design. It seems that the crudest and most primitive designs among the Bataks are representations of animals. The use of floral elements commonly accompanies a much higher conception, but this design stands at the very peak of Batak artistry. The Asahan Bataks have appeared to the writer as the most artistic of all the group, but he has seen nothing elsewhere that proves it so conclusively as this. The leaves are small, curved and convoluted in a variety of ways, but all are graceful, free and spirited in execution. The mass of leaves emerges from a conventional dragon's mouth, which is finely curved, scalloped and ornamented. The whole work becomes more admirable when one reflects that it was all done without any drawing of the design from which to work, and that it was executed in a most refractory material, unusually subject to splitting and cracking, in which one split would spoil the whole work. It must have been done with a knife less well adapted to such work than one of our ordinary pocket knives. All in all, one can regard it as the work of a genius, in both design and carving. The maker is unknown, but his work was prized by the former owner, the headman of the village of Soengei Boenoet, and it cost more to add it to the collection than did any other item.

No. 15 is a handsome weapon, though the writer was never able to understand the enthusiasm shown for it by every Batak and Malay by whom it was seen. To a man they admired it and wanted to secure it by gift, exchange or purchase. The blade is 15 cm. long, 1.5 cm. wide at the base and 6 mm. thick at the base of the back. It shows irregular and rather thick laminations. The tang is 1 cm. long and 1.1 cm. in diameter at its thickest part, which is next to the blade. The hilt is 6.5 cm. long and is carved with a lifelike representation of a parrot's head. The whole is carved from black buffalo horn, with small ivory insets for the eyes. The beak and crest of the bird are well represented. There is a false ferrule cut from the horn, which is ornamented with cusps and from which an ornamental design runs up the back of the hilt to meet the crest of the bird head. The sheath is of *kamoening* wood, except for the end piece, which is of buffalo horn. The sheath is made of four pieces well fitted and the whole is graceful. The top piece is made crosswise of the grain, pierced for the blade, and is ornamented with a bulbous lump which emerges from a conventionalized dragon's mouth.

Golok. — This knife is spoken of by Volz as having the form of the *golok taka*, which he says is used on the eastern plateau of Sumatra, but he does not describe it. Warneck finds it among the Tobas and spells its name

gulak. According to his definition, it is a "kap-messer." In the Asahan country the writer found it only in the form of the *golok rembau*. The significance of the name has not been ascertained by the writer, but the knife is much smaller than Warneck suggests. Furthermore, this type of *golok* has the magic property of protecting its bearer from attack by tigers. Hence it is sometimes called the *golok rimau* or *golok harimau*. The word *harimau* often shortened to *rimau*, means "tiger." Neither of the specimens in the collection would be of any use against a tiger except by its magic.

No. 16 is a most curious knife, which was obtained after long inquiry and search, and finally after much haggling and the payment of a stiff price. It is quite apparent that the natives believe implicitly in the power of this knife. The blade is 16.5 cm. long and 1.7 cm. wide at the base. The back is straight or nearly so, and the edge is straight until 3 cm. from the tip, where it begins to curve toward the back. It is only 4 mm. thick at the base. It is set in the hilt without a tang, or rather the tang is fully inserted, so that the blade comes up to the hilt. The blade is crudely made and has one roughly made groove along the back on each side.

The shape of the hilt is very unusual. It is curved somewhat like that of the *tordjong* or the *rendjong*, but in the opposite direction. It is 13 cm. long in the line of the curvature. It has a strong resemblance to a sea-horse and the likeness is heightened by eyes made of small pieces of mother-of-pearl. These were cemented on with gambier, but have now been lost. The end is finished with a silver stud of typical Batak design. A ferrule 5 mm. wide, crudely made of silver, binds the base of the hilt, which is made of a hard red wood. The hilt is further decorated by a design pricked out and filled with some white paste. Back of the eye on either side is a five-pointed star scratched in the wood, with the scratches filled with the white paste.

The sheath also is curious. The top piece, bottom piece and one side piece are all hewed from a solid piece of wood, with one side cut away to allow the hollowing. Then the other side piece is fitted in, a type of construction seen in only one other example, No. 10. A rough band of lead encircles the sheath near each end, and one of twisted rattan is seen below the upper one of lead.

The upper end of the sheath emerges from a dragon's mouth, and the tip is roughly carved in an incomprehensible design. This tip is ornamented on either side with a small silver stud, a circle of mother-of-pearl, and a triangular bit of lead, all cemented in place with gambier. Both ends of the sheath are further decorated with rude designs pricked and scratched in the wood and filled with the white paste used on the hilt. The sheath is made of hard, red wood.

No. 17 is really a *toembuk lada* and has nothing in common with No. 16 in shape of blade or hilt. It came into the possession of the writer on the eve of his

departure from Sumatra; otherwise an attempt would have been made to find out why it should be called a *golok rembau*. It was brought in by Bidin, who was mentioned at the beginning of this article, and sworn to by him as an authentic *golok rembau*, in spite of the protest of the author that it was a *toembuk lada*. The desire which the Oriental frequently shows to give the white man what he wants could not have been active here, because there was already in the collection one authentic *golok rembau* which had been there more than two years, and another was not being sought. Also the fact that this first *golok* had been secured at a fancy price could not have caused any deception, since the second one was offered very cheap, no more than would have been paid for it as a rather decrepit *toembuk lada*. Bidin himself could give no satisfactory explanation for the mutation of this knife from its original type to another one, but he vouched for the authenticity of the name and for its magical property as a tiger-repellent as well. The author can only express his doubts and admit that he may have been the victim of a hoax.

The blade, of typical *toembuk-lada* shape, is badly eaten by rust, especially at the tip. It is 15.5 cm. long, 1.5 cm. broad at the base, and 6 mm. thick at the base. A narrow shallow groove runs parallel to the back for the entire length on one side, but on the other side the groove extends only 2.5 cm. from the tang. The laminations show plainly and at the tip some of them have broken away, so that the blade has been damaged in this way as well as by rust. The tang is 1 cm. long and six-sided. The hilt is 6 cm. long and is made of a hard but light-colored wood, which has been stained black by some sort of varnish. The sheath is made of a softer wood stained in the same way as the hilt. It is unique among the sheaths in the collection in that it is all formed from one piece of wood hollowed out from each end. It has now split open along one side. The design, too, is different from that of any other sheath.

Koerambit. — This is a small knife with a curved blade and a hilt with a hole in it through which the index finger is thrust. The other fingers clasp the hilt below the widened portion in which the hole is made and the blade extends downward. However, the point of the blade curves upward when the knife is held in this way, and an upward stroke with it is only slightly less dangerous than that of a *rendjong*. On this account the *koerambit* is like the *rendjong*, a knife which the native may not carry.

Nothing is known of the extension of this knife in Sumatra; Volz does not mention it, and the writer has seen it only in Asahan, except for one example, No. 18, which he purchased in Medan from a peddler who did not know its origin. No. 18 was a new knife when bought and may have been made specially for sale, but aside from the fact that the Asahan Bataks now make no knives, and that it was bought far from their territory, it is obviously not of Asahan type. Hence it may be reasoned that the knife is not limited to the Asahan territory. No. 18 is undoubtedly a *koerambit*, but the

blade is not curved sufficiently to make it typical or of any great use in fighting. It is unfit for stabbing and would be ineffective in an upward stroke. It is figured here because it is nearer the true type than the only Asahan *koerambit* in the collection, No. 19. The writer has seen several specimens with the fully curved blades, but was unable to procure one.

No. 19 is a *koerambit* because it shows two characteristics of that knife. One is the perforated hilt and the other the hollow-ground, or, rather, hollow-formed, blade, since the hollow was made by hammering rather than grinding. This hollowed blade is seen in all specimens of this type and not in other knives. No. 18 also shows it. The blade of No. 19 is 11 cm. long, 2.3 cm. broad at the base, and 3.5 mm. thick at the base. The hollow grinding extends from base to tip and deeper on one side than on the other. The blade is atypic in having no curvature, and cannot have been of much service as a weapon, or for general purposes.

The hilt is 8.5 cm. long and is flattened with a wide extension through which the characteristic hole is made. It is made of hard, brown wood, and has a false ferrule cut out from the wood. The knife has no sheath.

Goepuk. — As it exists in Asahan, this knife is a rather small one. Elsewhere in Sumatra the writer has not been able to see it, nor does Volz mention it. Warneck, however, does list the word as *gupak*, which he translates *hackmesser* and which he says is an Angola word. This suggests a knife larger than the examples in this collection. As seen here, the blade of the *goepuk* has a backward-curved edge. In two of the examples the back, too, is curved, but in the third it is straight in the basal part of the blade and curved in the terminal third to form a scimeter-like point. The form of the blade, as well as its weight, gives one the idea that this is for general purposes rather than an offensive weapon.

No. 20 has a blade 24 cm. long, 3.3 cm. wide in the middle, and 6.5 mm. thick at the base, its thickest portion. It narrows down to join the hilt, but has no distinct tang. It is well shaped and well made and has enough weight at the point to render it useful for light chopping. The hilt is 8.5 cm. long and is carved to represent a parrot with berries or seeds in its beak. There is a rather faintly suggested false ferrule 1.3 cm. wide. A hard, rather light-colored wood was used in making both hilt and sheath.

The sheath consists of a top piece and two side pieces which are mortised into it. There is no bottom piece, but the lower end is closed by the two side pieces. Two braided bands of rattan are fastened around the two side pieces, one near either end. The whole is well shaped and fits the blade well, but the finish is crude.

No. 21 has a blade 15 cm. long, 2.2 cm. wide at the middle, and 4.5 mm. thick at the base. Both edge and back of the blade are curved and the blade tapers so that it is only 8 mm. wide where it joins the hilt. This is 8.5 cm. long, but only 2.5 wide in its widest part, and is

flattened in the plane of the blade, so that it has an ellipsoidal cross-section. There is no sheath to this knife, probably because it was not carried, but was used around the house. The blade is of good material and is strong and very rigid.

No. 22 is much lighter and flimsier than No. 20 or No. 21, though the blade is longer than that of No. 20. The blade is 25.5 cm. long, 2.2 cm. wide at the base, and only 3 mm. thick. Both edge and back are curved from tip to hilt. The blade is of native manufacture and laminated. It is uneven in thickness and shows hammer marks. The temper is so bad that the blade can easily be bent out of shape with the fingers. The hilt is 7.5 cm. long and is curved and flattened. It is ornamented with a design of overlapping leaves emerging from a conventionalized dragon's mouth. There is a false ferrule 2.3 cm. wide. A soft red wood was used for the hilt, which is well designed but poorly executed. The sheath is of the same material and is made in two pieces. On one side is a rectangular boss ornamented with a rectangular design. This boss is perforated to allow the passage of a thong or cord for attaching the sheath to a belt. Three roughly braided rattan bands bind the sheath.

Halasan. — This is a very common knife among the Karo and the Toba Bataks and several examples are figured by Volz. Volz, however, calls the weapon a *kalasan*, a change of one consonant only. The Toba language originally did not contain the k sound, though a few words, mostly of Malay origin, that contain this sound, are now included in it. It is natural, then, for the Toba name to be *halasan* and, since the Asahan language is a derivative of the Toba, we find the same name current in Asahan. This type of knife is not a very common one in Asahan, though it may have been more widely used in former, warlike times. It was used not only for fighting but also as a hacking knife to cut lianas and other plant growths from the trail. It is only by the constant use of such knives by travelers that the trails are kept open. For this purpose it has largely been replaced in Asahan by the less aristocratic *parang* of Malayan origin, and since the Asahans no longer carry on wars the *halasan* is not often seen.

No. 23 (Pl. VI) is the only Asahan *halasan* in the collection. It is smaller than most blades of this type. The blade is 41 cm. long, 2.3 wide near the tip, where it is widest, and 6 mm. thick at the base. The tang is 2 cm. long, 1.3 cm. wide and 8 mm. thick where it enters the hilt. The base of the blade has an ornamental guard composed of several teeth. Distinct laminations show in the blade, which is well finished and well tempered.

The hilt, which is 14 cm. long, is round at the point where the blade enters, but flattened at the outer end, which is a typical *Palembang* hilt. There is no ferrule and the hilt has split badly because it was not bound around the tang. A very hard, dark brown wood is the material of the hilt, which was stained black with some resinous substance.

The sheath is a crude affair made of two pieces of a soft, light wood bound together with two simple bands of rattan. It is noteworthy that the small knives have sheaths with a top piece, or at least an upper end, which has a horizontal extension, usually with some sort of decorative treatment, and sometimes, as in No. 14, a very elaborate and beautiful design. The larger knives, on the contrary, either completely lack this horizontal extension or have only a faint suggestion of it. This is not due to the lack of ornament on the larger sheaths, because, although some of the larger knives have only temporary crude sheaths, others have finely made sheaths like that of No. 25, or sheaths elaborately decorated with silver and copper, like that of No. 26. The reason is that the smaller knives are tucked in a belt, a *slendang*, a long scarf sometimes wrapped around the waist, or the top of the *sarong* already mentioned. The horizontal extension prevents the knife from slipping through the girdle and keeps the hilt within easy reach at all times. It also keeps it in sight, so that the beauty of the weapon can be displayed properly, and many of these knives were carried quite as much for show as for defense.

This evolution of the horizontal extension probably also played a part in the development of the construction of the sheath. The use of the top piece may have been due to this, since the top piece is not seen in any sheath too large to be tucked in a girdle. The extension is very liable to split off if carved across the grain of the long side pieces of the sheath. The introduction of a top piece with the grain running at right angles to the side pieces was a logical development, since only in this way could a durable sheath be made.

The end piece of the sheath is less often seen and appears to be a later development, the purpose of which was to hold the side pieces more securely and to prevent them from splitting.

Nos. 24 and 25, typical examples of the Karo *halasan*, are included here to show different types of guard on the blades.

Hangan. — No. 26 is the only example of the *hangan* which the writer has seen. In form it is a type of the *klewang* described and figured by Volz. The *klewang* is very widely spread in Sumatra and it seems likely that the *hangan* is identical with it, though No. 26 is considerably smaller than the typical *klewang*. The blade is 43.5 cm. long, 4 cm. wide at the top, and 8 mm. thick at the base. It thins out gradually from base to tip, but narrows in the opposite direction, being widest at the tip. The tip is blunt, with a short round from the back to the edge. Both back and edge are curved throughout their length.

The hilt, which is 12.5 cm. long, is made of a hard, brown wood and carved with a conventional dragon's mouth, *kapala Palembang*. There is a ferrule 2.2 cm. wide made of two pieces of a hollow bone and roughly fastened with two bands of iron wire.

This knife has no sheath, probably because of the clumsiness of a sheath which would take such a long curved blade. These long curved knives either have no sheath or are merely wrapped for carrying in a piece of the leaf sheath of a palm, as Volz showed (2, Vol. 2, Fig. 106). The curved blades, which are long but slender, can be housed in a neat sheath, but the *hangan*, the *klewang*, etc., have a broad blade and a blunt point and so are usually carried in the hand without a sheath.

Simoenoeng. — This is a peculiar knife not like any other seen in Sumatra. Its straight back and curved edge ally it with the Karo *rudus*, but it is a smaller knife, and has a unique tip with a curious backward-curved piece of metal which the *rudus* does not have. Nothing is known of the origin of the name. The blade of No. 27 is 30 cm. long, 4 cm. wide at its greatest expansion near the tip, and 6 cm. thick at the base. It is of rather crude workmanship. The hilt is 15 cm. long, of hard, brown wood and carved with a *kapala Palembang*, slightly hollowed out on the lower side. A false ferrule is formed by two raised rings which are carved out of the wood of the hilt. The hilt is cut off with a slant where it joins the blade, and the rings of the false ferrule parallel the diagonal slant. This type of lower end of hilt is seen in some *klewangs*, but there is no other Asahan knife with such a hilt. There is no sheath on this knife.

Alamang. — This is one of the types of sword of which there are many in Sumatra. As has been pointed out, the fighting days of the Asahan Bataks are over, and such weapons as these are now rather rare. No. 28 is the only specimen seen by the writer; at least it is the only one he can remember. The blade, which is curved on edge and back, is 55.5 cm. long, 3.8 cm. wide and 6 mm. thick at the base. It is of native manufacture and shows laminations very plainly. It is hollow-ground on each side from the back about halfway to the edge. There is no tang exposed, but the blade keeps full width up to the hilt. It may be seen, however, that the tang, which is thrust into the hilt, is only about half the width of the blade. The hilt is made of a massive piece of buffalo horn now cracked and gnawed by rats. It is 14.5 cm. long and is carved with a *kapala Palembang*, in which the tongue emerging from the dragon's mouth is worked out in a leaf design, with the carving left unfinished. There is a narrow false ferrule consisting of a rounded band carved from the horn. The sheath is a very poor affair made of two pieces of soft wood. It is held together by one braided band of rattan and two plain bands of the same material.

Kris. — The *kris* is the best known over the whole world of any of the weapons of the East Indies, because of the rather frequent references to it in literature, especially that of a somewhat sanguine type in which the *kris* becomes the lethal weapon in the hand of a mysterious assassin. Among the Malays it is common, though in these days it is worn for ornament more than for use. The hilt is almost always carved to represent a seated figure, No. 29 shows this, though the figure is

considerably conventionalized. The blade of the *kris* is usually wavy; the larger the number of curves the more desirable the blade, but No. 29 has a straight blade which is by no means uncommon among the Bataks. These people are not nearly so fond of the *kris* as are the Malays. No. 29 is not an Asahan weapon, but is very like some seen in Asahan, and is included to show the type. It probably came from Alas-land.

Podong. — This is the sword or saber, which is very common all over northern Sumatra. It is most likely that this weapon is of European origin, and, in fact, many of the examples seen bear trade-marks which show that they were made in Europe. Some of the marks, however, are imitations, as Volz has proved. Many of the swords are very handsome and have hilts covered with braided silver wire. Although examples were seen in Asahan the writer was unable to secure any of them. The two figured in this collection were purchased in Brastagi in Karoland and are of unknown origin. No. 33 has a fine blade of excellent steel, which bears no trade-mark, though its quality suggests that it came from Europe. It is 60 cm. long and 2.5 cm. wide at the base, and is hollowed along the back. The hilt is roughly cast from iron, with a guard in the form of a cross and a chalice on the pommel. The chalice has a scalloped leather pad inside and an iron button in the center. In similar specimens the author has seen a tassel, which is attached to this iron button, but this weapon had none when purchased.

No. 34 is a native product beyond any doubt, for it shows the characteristic laminations and is a very poor piece of work in general. The metal is very soft and has little temper, so little that it may be bent permanently with the fingers. The blade is of nearly the same size as that of No. 33, having a length of 57 cm. and a width of 2.8 cm. at the base, and is hollowed only slightly. The hilt is curious in that it is a native imitation of that on No. 33, but it is cast in brass. It is more clumsy than that of No. 33 and is considerably shorter.

No. 34 has no sheath, but No. 33 has one which is well made and well fitted. It is made of soft, brown wood and covered with red cloth, which apparently has been given a number of coats of some sort of black varnish. The varnish has cracked and checked to such an extent that it looks like very old and rotten leather. The tip of the sheath is expanded in an unusual fashion, which suggests to the writer, at least, a Persian influence.

TYPES OF HILTS OF BATAK WEAPONS

The author has spent much time in trying to puzzle out some of the curious hilt types seen on the weapons of the Asahans and other Bataks. Volz has made a good deal of the question whether the hilts curve away from the edge or toward it, but it has been shown above that the type of blade is what determines the knife's name, not the hilt.

The hilts, however, are more or less standardized for each type of blade, so far as general curvature is concerned, but there is less uniformity in the pattern. Each artisan seems to work out his design as best suits him, though of course there is some restraint due to the nature of the blade for which the hilt is being made. But when one studies a number of these knives one finds that, though there is a great deal of difference in detail, most of the hilt types fall into a few classes. Thus far the writer is able to distinguish two main types of hilt into which nearly all the hilts, not only of the Asahan weapons, but of the other Batak weapons as well, may be fitted. One of these is the *kapala naga* or "dragon's head"; and the other is the *kapala bajan* or "parrot's head." When one has observed a rather large number of knives one finds that certain hilt types, which at first seem to have no relation to the types mentioned here, are really part of a series and become understandable when considered along with others of the series.

The *kapala naga*, or "dragon's head," is very common indeed on many different types of blades. In Plate VII an attempt is made to show the relations of the different knives of the collection which have this type of hilt. No. 1 is an obvious and rather realistic dragon's head carved from bone, with the hollow of the bone forming the opening of the mouth. One must not assume, however, that the mouth has an opening only because the bone was hollow. Volz is led into error in regard to what he calls the "split-grip," which is represented by No. 30 in this series and which is the culmination of one line of development of the dragon's head. It was the idea of Volz that the split in the end of the grip was due to the fact that the buffalo horn is solid only a little distance from the end and hollow for the remainder of its length. Accordingly, the outer end of a knife hilt made from this material is hollow and, if the sides are shaved off to flatten the grip and render it more comfortable to the hand, one gets as a result two spreading extensions with a space between them. This, according to Volz, is the origin of the split-grip.

Now with this much settled, Volz goes on to speculate about the probable age of the split-grip, which he says must be recent, since the buffalo did not exist in the old Malayan culture, but was introduced by the Hindus. Buffalo horn was indispensable in the construction of such a knife and hence the knife could not have been known to the pre-Hindu Malayan culture, but must be a Hindu introduction. No. 10 is a hilt which seems to upset Volz's too finely spun theory, since it has the hollowed mouth of the dragon, not because of the use of a hollow bone or horn but for the very good reason that a dragon's mouth ought to be hollow. The designer has gone to great trouble to make the mouth in that way because wood was used for the hilt and had to be hollowed out to develop the idea. In No. 27, too, there is some hollowing of the hilt, which is also of wood. The writer, therefore, does not agree with Volz here, but feels that Nos. 1, 10 and 30 form a continuous series in the *kapala naga* development.

But there are a number of other variants of the *kapala naga* which are surely related to one another, but not so surely related to the three already discussed. These, to be sure, have the idea of the gaping dragon's mouth, but they differ from the others in the presence of a tongue, which Nos. 1, 10 and 30 do not have. If we begin with No. 23, it is possible to arrange a reasonable series of forms among the others. No. 23 is a type called *kapala Palembang*. This is very suggestive, since the Palembang region was strongly influenced by the Hindu culture, which must have reached the Asahan area in an attenuated form. We may suspect, therefore, that the Palembang hilt is of Hindu origin, and in fact we become very sure of it when we look at it long enough to see in it, as we must in the end, the *makara* of Indian architecture. The *makara* is said to be a sort of dolphin, or a shark, and the Hindu has the *naga* as well. Hence it may be that the *kapala Palembang* is not a *kapala naga*, as Nos. 1, 10 and 30 are. No. 10 cannot be any sort of shark or dolphin because, in addition to the hollow mouth, which has been mentioned, it has the scales of a snake carved on the head and has teeth as well. The scales are very realistic, though they appear to be scales from the body, rather than from the head, but one cannot complain of that, since one gets a definite notion of a snake, or some snakelike animal, which was doubtless what was intended.

No. 28 also is called a Palembang hilt, and it, too, is a *makara*, but one with a tongue more elaborately carved. Nos. 9 and 22 belong to the same general series with a very simple jaw line, but with a tongue conventionalized into a mass of leaves. The Asahan does not see the Palembang hilt any longer in this, but calls it a *kapala soenggil Serani*, or a "Syrian hair knot." One cannot deny the resemblance, but there can be no reasonable doubt that the series runs as stated above.

No. 11 starts a new line of the Palembang series. The slant of the hilt is different from that of the others, and this makes the whole hilt look different, yet examination reveals the lines of the open mouth and a short, but definite, tongue. There is a jump from No. 23 to No. 11, but these two must be a part of the same general series. From No. 11 it is easy to pass to No. 14, which reveals the lines of the jaw plainly enough. But here the tongue is very highly developed and gives rise to a *boenga hoenik*, or "*hoenik* flower." Though No. 14 manifests a play of imagination in the development of the idea shown in No. 11, in No. 13 we have, on the contrary, a further simplification of the idea, with the result that of itself No. 13 would not be suspected of representing any mythical or other animal. When it is compared with the others of the series there seems little doubt that it belongs with them.

From No. 23 to No. 26 is another leap of considerable magnitude, for the type has undergone notable changes. Yet No. 26 is still recognized as a *kapala Palembang*, which it is beyond doubt. However, the next hilt in the series is given a new name, in spite of the fact that it is

more like No. 26 than No. 23. This No. 27 is a *simoenoeng*, so far as the blade is concerned, and the hilt, too, is called a *kapala simoenoeng*. The principal differences between Nos. 23 and 26 are that No. 26 has the base of the hilt cut on a slant and that the mouth is slightly hollowed out.

Nos. 7 and 8 must be seen in the series for one to understand how they can have any connection with a *kapala naga* or a *kapala Palembang*. One can see in them, however, the main lines shown in No. 27. Though they are a type in themselves, known as a *kapala toras*, which has definite elements, the number of parts in the design and the general disposition of these parts make it almost certain that Nos. 7 and 8 came from such a form as No. 27.

No. 21 becomes understandable from Nos. 7 and 8. There has been a reduction of parts from those two, but the general idea is still visible. This type is given a special name, *kapala lindoeng*, but what may be the significance of the name is unknown.

The *kapala bajan*, or "parrot's head," is rather more obvious in most of its forms than is the *kapala naga*, but even so it is not always taken for what it really is. On this type, too, Volz made some mistakes, especially when he considered some of the very highly conventionalized types of *kapala bajan* as "knob-hilts." Of course, not every knife with a knob on the end is a *kapala bajan*, but some of the knob-ended hilts are undoubtedly members of this general series.

No. 15 (Pl. VIII) serves well as the beginning of the *kapala bajan* series because it is a realistic representation and there can be no doubt that it represents a bird, and, more definitely, a parrot. The beak, the eye and the crest are all very natural. Some hilts have been seen by the author which have these characters and, in addition, a fine representation of the feathers all over the head, so that the carving becomes almost a portrait of some individual bird. The transition to such a hilt as that of No. 20 is slight, for here again we have a very good likeness and it is only the lack of the eye that makes No. 20 less naturalistic than No. 15.

No. 18 is still readily recognizable, though there has been more conventionalization than in any of the preceding specimens. The beak is hardly more than an ornament, yet the curves are revealing when they are examined in detail. The point is undercut in such a way as to make it plain that this is really a beak. The eye is very much enlarged, not because of the needs of the design as such, but rather because the knife is a *koerambit*, and that knife must have a perforation for the finger. No. 19 is subject to the same necessity and the hole is made larger than in No. 18, with the result that the knife has a more efficient hilt, even though the likeness is less noticeable. Here the beak is barely suggested, and one would hardly see the slight point developed on the edge side of the hilt if one had not been warned by other knives of this series. No. 19

seems to be the culmination of this line, since little remains to remove if one is still to have a *koerambit* with its perforated hilt. The faintly suggested beak could be removed, and that is all that could be done. No. 17 belongs somewhere in this series, but has no very near affinities among the hilts already discussed, or with others to come into the discussion later. It is called a *kapala toeng-toeng* by the Asahan people, which name may have a special significance, though none was discovered by the writer. It does not seem unreasonable to consider that this, too, is a *kapala bajan*, for the little point on the edge side of the hilt can hardly be anything other than a beak. Volz refers to such knives with a knob-hilt as having a point on the knob, but seems to miss the significance of this point. The thin raised ridge above the point may represent the crest of the bird, but this cannot be asserted with confidence.

From No. 20 one passes easily to No. 25, for the changes are not great; there is a little more curve of the hilt, so that the beak becomes turned under. In this the eye is shown by an ornamental boss of the copper, which the Karo Bataks are fond of using. This knife as well as the next two of the series is a Karo knife.

No. 24 is the next in this set and shows a further turning under of the beak. The eye, too, has disappeared from the hilt and the likeness to a head of a bird has been considerably diminished. A hilt almost exactly like that of No. 24 is figured by Volz as a knob-grip, and he seems not to have sensed the *kapala bajan* in it at all.

In No. 31 we have a highly conventional treatment of a hilt. At first glance it is almost exactly what one would expect to develop as an outcome of an attempt to make a simple curved hilt. But such a treatment will not account for the line on the under, or edge, side of the hilt. This line, or rather, ridge, has a reverse curve under it and requires only a glance to be recognized as the beak of the *bajan*, which we already have in several forms. Whether this is the culmination of the line or whether No. 12 is a further development is not certain. The writer is inclined to think that it is a further development of the same idea, but it may be hard to convince others of the correctness of this assumption. Most of these hilt designs are not the result of chance, as has been shown, and this particular one could very well have come from the extension of the series which has just been discussed.

No. 32 does not belong in the *kapala bajan* series, but is put in here because it shows another type of bird's head, namely, a cock's head. This is not an Asahan knife, but was bought from a peddler and is under some suspicion of having been made for sale to tourists. Yet it, too, in all probability, had a definite precedent for its type, and it serves to show that such a head might be the origin of another whole series of hilt designs.

RELATIONSHIPS OF THE WEAPONS

It has been necessary to draw on a large field to secure the different series of hilt types to illustrate the origin of the various designs. In spite of this, the author believes that the types of a series are all related, though some have become so fully conventionalized that their origin is not suspected by the makers of the knives. The different forms are coexistent, so that the progress of conventionalization is not a matter of time, or stage of civilization, but is probably a matter of the craftsmanship and art sense of the individual. Without trying to lay down any rule concerning the manner of development of design among primitive peoples in general, the author wishes to record his idea of the growth of design among the Asahan Bataks. Here it seems that the most primitive-minded individuals aim at a realistic rendering of natural objects particularly animals. The execution of the idea may be crude, as it usually is, or may be very good. With an increase in taste there seems to be a tendency to insist less on a portrait of the object than to suggest the object represented, and then to add some extraneous ornament. Those individuals who have taste of a very high type carry on the conventionalization to a degree still higher, and introduce the graceful leaf designs which are so well used on some of these Asahan weapons. These designs are out of the range of the ability of the primitive-minded individuals, both in concept and in execution, yet both these classes of workers may be making knives at the same time. After the skilled designer has worked out a conventionalization of an animal, a less skilled worker may copy it with the omission of some of the delicate and beautiful ornament, so that one who comes across his work later on may say: "Here are crudity and conventionalization combined; here is a primitive conception of art." The writer is convinced that this is not true for the Asahan people, whom he has observed over a considerable period of time. The crude concept seems always to be a realistic one, however poorly the object may be imitated.

The designs of the sheaths seem to show a resemblance to only one of the hilt designs, namely, the *kapala naga*. It may be carrying the idea too far to see the resemblance in them, but it does not seem so to the writer, who has spent much time in examining the specimens and in attempting to find reasonable explanations of them. Mention has already been made of the horizontal boss which is formed on the upper end of the sheath so as to keep the knife from slipping through the belt or girdle. It is this part of the sheath which is most commonly ornamented in Asahan knives, although Karo and Toba sheaths may have elaborate ornaments of silver and copper at the lower end of the sheath and numerous bands throughout the length of the sheath.

In No. 15 (Pl. IX) there is a definite set of lines which suggest the opening of the dragon's mouth, from which a rounded mass of wood emerges which may be taken to

represent the tongue. This is, then, a *kapala Palembang* or *makara* type. In No. 22 the same thing is seen, but the sheath ornament is almost an exact duplicate of the hilt design, and that design has already been explained as a *kapala naga*, although called a *soenggil Serani* by the natives, who have lost the idea of the dragon's mouth because of the conventionalization. In No. 10 there is only a slight suggestion of the mouth, and the leafy scroll which emerges from it is not at all suggestive of a tongue. It is slightly closer, however, to the original type than the one which seems to follow it in the series. In the latter example, No. 8, there is no longer any mark which indicates even vaguely the dragon's mouth. Otherwise it is very like No. 10.

If we pass to No. 7, we find a sheath ornamented, if one may call it that, by a plain area or boss of a sort of shield shape which is raised above the remainder of the sheath, but is otherwise not distinguished from it. It is conceivable that this design may have been derived from one such as is seen in Nos. 8 and 9. The latter has not been mentioned before, but it is almost identical with No. 8, except that it is of much finer workmanship.

Another series may be traced from No. 22 through No. 16, which shows a decided peculiarity in that the whole upper end of the sheath emerges from the mouth, instead of only the horizontal boss, as in most of the others. No. 13, which comes next in the series, is much the same, but here there is a line on only one side to suggest the opening of the mouth and nothing at all on the other side.

No. 18 may be an offshoot of this idea, but one can hardly be positive of it, and No. 32, with its elaborate scrolls, may be only a development of the type in No. 18.

No. 20 has strong resemblances to No. 13 in the little toothlike projections on the outer and upper part of the sheath. Nos. 2 and 4 seem to be a simplification of this design.

In No. 11, however, the undoubted simplification takes a form different from that shown in Nos. 2 and 4, and the projecting part becomes greatly elongated. We may pass from this to No. 17, which has a horizontal extension of as simple a type as could be found anywhere. Nos. 5 and 6 may represent a further simplification from No. 11, but on the other hand they may belong to a series totally different.

No. 14, with its magnificent carving, seems to be an elaboration of such a form as that seen in No. 22. It evidently does not belong in the longer series, but is rather the high point in the development of that particular idea.

OTHER WEAPONS

The blowpipe, or *soempitan*, is not very common anywhere in Sumatra in these days, and is very rare in Asahan. The writer was able to see two or three examples, but was unable to secure one, although he

was always hopeful that some of the promises to procure one for him would be fulfilled. The inside tube of the *soempitan* is made from a species of bamboo found in Asahan which has very long internodes. The inner tube is supported by an outer tube made of a larger bamboo, or a piece of palm trunk, split and fitted around the inner tube to which it is cemented by some resin or gum. The darts are fashioned from pieces of the midrib of palm leaves and are usually made with a point so cut as to break off in the wound. They are carried in a quiver of bamboo, with their poisoned tips down, so that they may not scratch the user. The kind of poison used has not been investigated by the writer. The base of the dart is wrapped with a bit of kapok, and the dart is slid into the tube, which it fits loosely. To one who has never before seen a blowpipe used, the time which elapses between the beginning of the blowing and the exit of the dart seems very long. The flight of the dart, however, is very swift and true. In spite of the decline in its use one realizes that the blowgun is no mean weapon.

Very old smooth-bore muskets are fairly numerous, but they are held at a rather high price because in Sumatra natives are not allowed to buy firearms, and they naturally prefer the crude old ones to none at all. Nearly all the muskets have old Spanish dollars sunk into the stocks, further evidence of their age, although why such an expensive mode of ornamentation is used is not clear. The coins could be beaten out into plates and used much more effectively, but this is not the custom. The Achinese make, or used to make, brass cannon of all sizes, but no weapons of this kind were ever seen in Asahan and it does not appear that the Asahan artisans ever developed the skill to make them.

The only other Asahan weapon of importance is the spear, or *toembuk*, which is quite common and which has been used in the past for fighting. At present, it is used to kill tigers and wild pigs, and is carried also as an ornamental staff and as a symbol. Two specimens are included in this collection: one, No. 35, is an ornamental affair and the other, No. 36, is an effective weapon which has slain its share of pigs. No. 35 has a blade 27.5 cm. long and 2.2 cm. wide, made of native steel which shows many laminae. It is rather thin and not well tempered. The tang has four ornamental rings and is thrust into a shaft of hard, red wood. The shaft is bound around the tang by a silver ferrule, 12 cm. wide, which is finely decorated with a design of leaves spiraling between bands which are incised with semicircles to suggest the coils of a serpent. There are two rings at each end of the ferrule between which a design of triangles bearing spreading rays like a sun is engraved. A perforated disk of silver is fitted between the ferrule and the blade, and this also bears the triangular design on its upper surface. The shaft is 128 cm. long and 2 cm. in diameter, and has on the end a counterpoise 14.5 cm. long, carved from the round. No. 36 is much heavier than No. 35. Its blade is 29.5 cm. long and 4 cm. wide. Four rings on the tang take up a space of 2.5 cm. above the ferrule, which is of brass and which is 1.5 cm. wide. The shaft, which is

made of a very stiff and strong rattan stem, is 105 cm. long and 2.5 cm. in diameter; there is no counterpoise. No. 35 has no sheath, but No. 36 has a sheath made of two pieces of soft wood held together by two bands of rattan.

In this paper it has been the purpose of the writer to give a description of a collection of the weapons of the Bataks of Asahan, a little-known tribe of the East Coast of Sumatra, and to make some observations on the possible origin of designs of hilts and sheaths of Batak knives.

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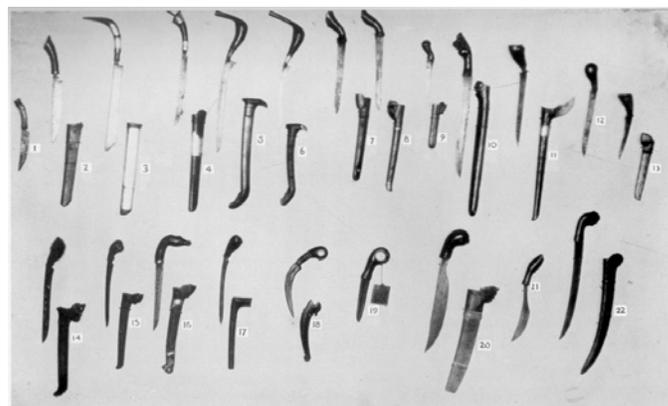
LITERATURE CITED

1. BARTLETT, H. H. 1926. Sumatran Plants Collected in Asahan and Karoland, with Notes on Their Vernacular Names. Pap. Mich. Acad. Sci., Arts and Letters, 6 : 1-66.
2. VOLZ, WILHELM. 1909, 1912. Nord-Sumatra. Vol. 1, xiii + 395, 3 maps; Vol. 2, xiii + 428, 2 maps. Dietrich Reimer (Ernst Vohsen), Berlin.
3. WARNECK, J. 1906. Tobabataksch-deutsches Wörterbuch, Vol. 1, 252 pages. Landsdrukkerij, Batavia.

EXPLANATION OF PLATES

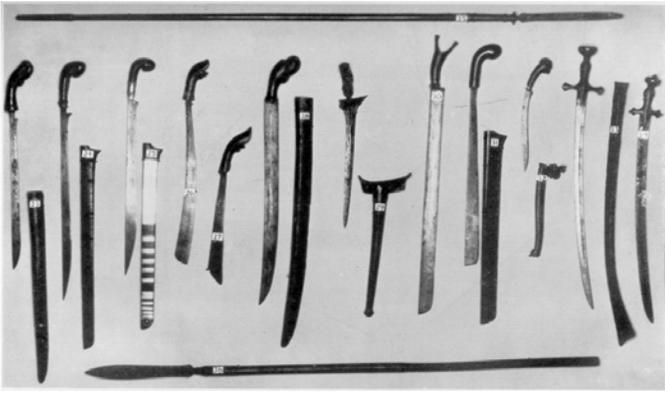
Unless a statement to the contrary has been made in the text all the weapons illustrated are authentic Asahan specimens. All are in the author's collection.

PLATE V



Types of knives and hilts. Names of knives are given first and those of hilts follow: 1, raut, naga; 2, raut, boenga kiambang; 3, tordjong, hinata; 4, tordjong, hinata; 5, rendjong, rendjong; 6, rendjong, rendjong; 7, badik, toras; 8, badik, toras; 9, badik, soenggil Serani; 10, badik, kapala naga; 11, bolado, toras; 12, bolado, boenga ponong; 13, bolado, toras gading; 14, toembuk lada, boenga hoenik; 15, toembuk lada, kapala bajan; 16, golok, golok; 17, golok, toeng-toeng; 18, koerambit, kapala bajan; 19, koerambit, kapala bajan; 20, goepuk, kapala bajan; 21, goepuk peragit, lindoeng; 22, goepuk, soenggil Serani

PLATE VI



Types of weapons. Names of knives are given first and those of hilts follow: 23, halasan, kapala Palembang; 24 halasan kapala Palembang; 25, halasan, kapala bajan; 26, hangan, kapala Palembang; 27, simoenoeng, simoenoeng; 28, alamang, kapala Palembang; 29, kRIs, buaja domum; 30, sikin, kapala naga; 31, samaremu, kapala bajan; 32, rending kapala manoeck; 33, podong; 34, podong; 35, toembuk; 36, toembuk

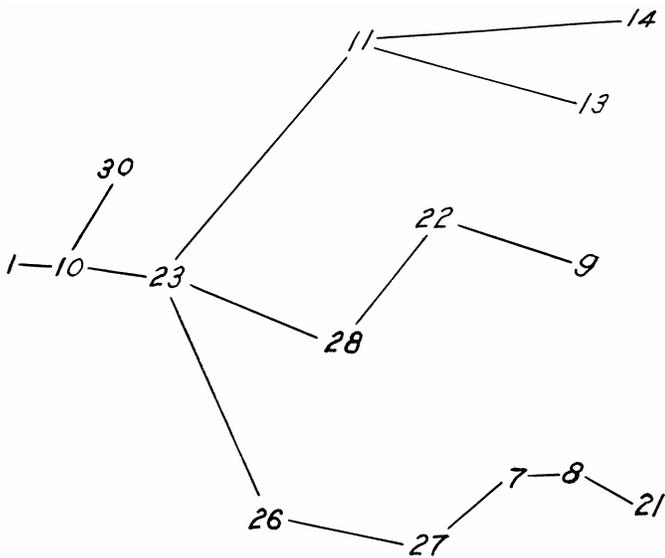
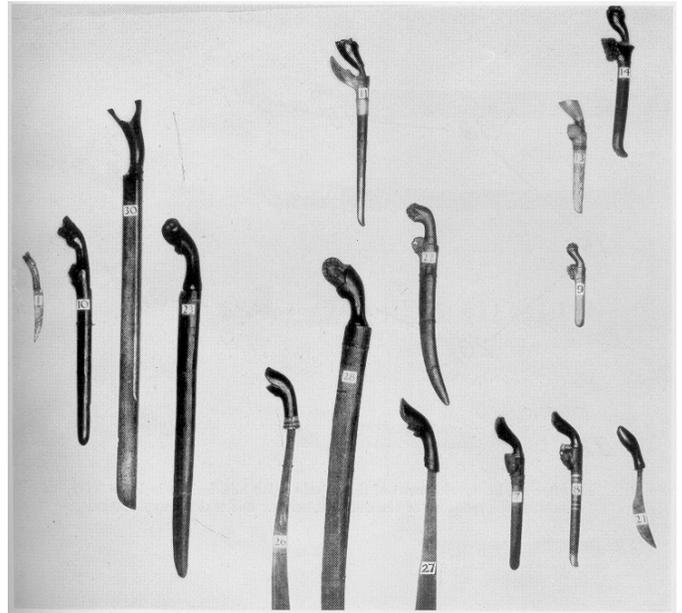
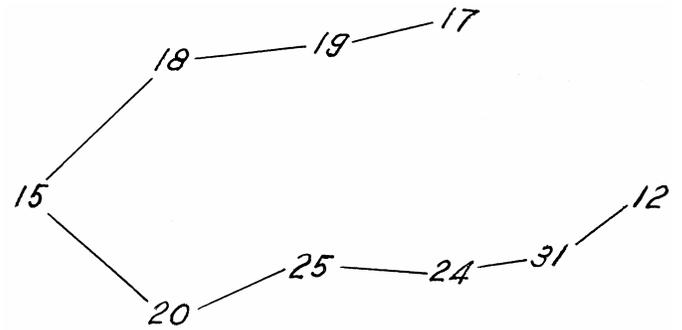


Diagram of the development of the *kapala naga* and *kapala Palembang* hilt designs in Plate VII, showing the relations of the different series. See text for explanation

PLATE VII



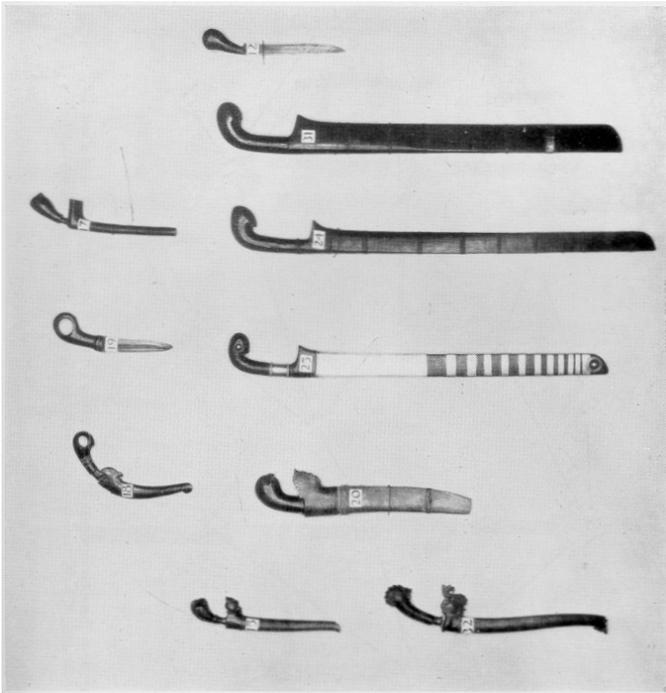
Kapala naga and *kapala Palembang* hilt designs



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Diagram of the development of the *kapala bajan* hilt designs in Plate VIII, showing the relations of the different series. See text for explanation

PLATE VIII



Kapala bajan hilt designs

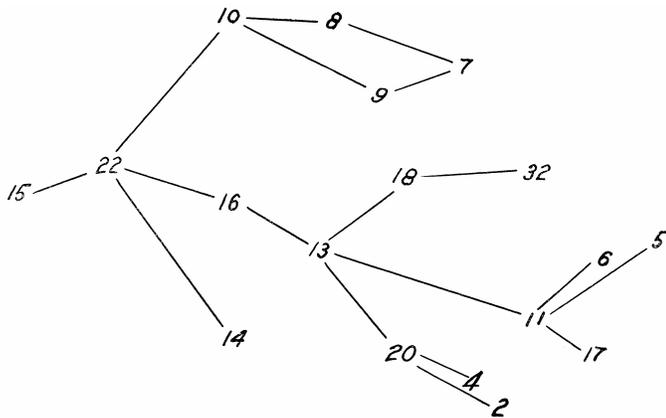
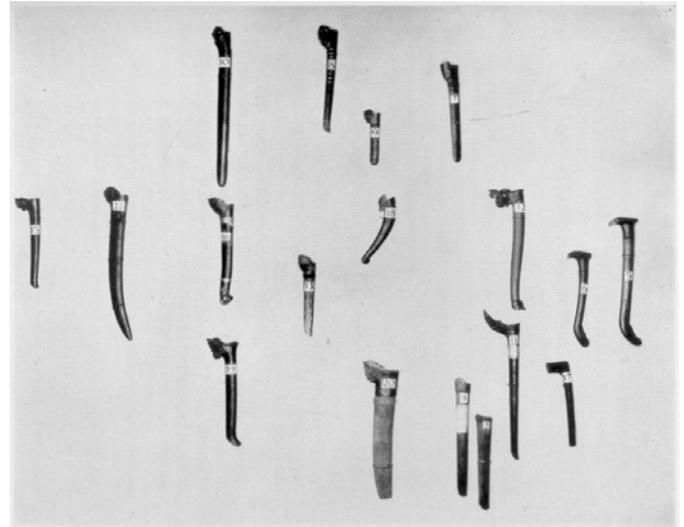


Diagram of the development of the *kapala naga* motif in sheath designs in Plate IX, showing the relationship of the different forms. See text for explanation

PLATE IX



The *kapala naga* motif in sheath designs

THE HYDROGRAPHIC REGIONS OF MICHIGAN

CHARLES M. DAVIS

THE pattern which the drainage system of an area makes upon the surface of the land is a prominent feature of the landscape. It affects the distribution of human habitations and the lines of communication. Of those primary human necessities which are limited in extent, water is one of the most important and its distribution profoundly influences human activities.

This classification of the drainage-system patterns of Michigan is based upon the form of the pattern as seen on a map, and not upon the characteristics of the stream valleys. A youthful stream may be a part of a mature pattern. Most of the drainage of Michigan is youthful in form, but its pattern is mature.

The pattern formed by streams and lakes is determined by many factors. The slope of the land surface, the soil material and the underlying rocks all affect stream courses. The drainage pattern is not a static thing. At almost any place along courses of streams can be seen the scars of earlier cutting. The pattern of a stream system today is probably different from what it was in the past and from what it will be in the future. The age of a stream is not a matter of time alone, but of the relative completion of the work to be done. A stream flowing over sandy drift quickly cuts down to base level and begins to meander, whereas an equally rapid stream flowing over hard rock may take hundreds of times as long to accomplish the same result. Lakes, too, are not constant in form. They are attacked by vegetation which fills up their beds and by streams whose headwaters cut back and may drain the lakes. Each drainage system has an individual configuration, yet these systems form

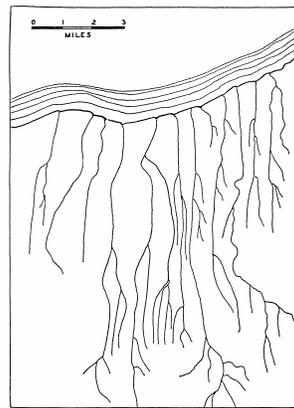
distinguishable types. It is possible to pick out areas in which the drainage pattern is essentially similar throughout. Such areas may be called hydrographic regions.

The surface features of Michigan are largely the result of the advance and retreat of the continental glaciers. In a few places the glaciers have scoured and scraped, leaving the rock bare, but generally they have deposited. The immense amount of material carried by the glaciers has been dumped on the surface in a system of moraines and outwash plains, river beds and lake plains. The stream patterns are in a large degree consequences of this deposition.

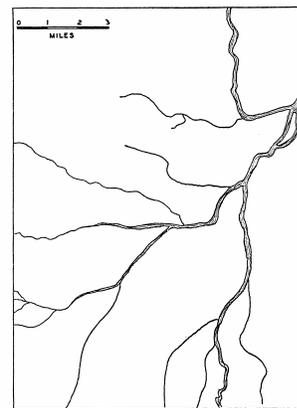
The streams must make their way across the irregularities of such a surface as best they can. They must swing around moraines, fill up basins, lose themselves in swamps, and everywhere depart from straight and direct courses to outlets. Notwithstanding these difficulties they have in most places developed patterns which can be recognized, in spite of irregularities, as dendritic types. In such patterns the stream and its tributaries resemble the veins in a leaf, with the tributaries joining the main stream at angles of approximately forty-five degrees. This pattern exemplifies most of the drainage systems found in Michigan, which are present in youthful and mature stages.

Youthful dendritic patterns are found where streams flow from a highland area to the lakes without crossing an extensive lowland. Such streams maintain in almost straight courses their individual channels from headwaters to outlets. They have not developed into systems of main and tributary streams. The resulting pattern is one of many parallel straight channels with few tributaries except at the headwaters on the highlands (Map 3 A). A region of this type of pattern is found along the northern shore of the Northern Peninsula from the state boundary to Keweenaw Bay. In the Southern Peninsula it is found along the eastern shore of the "Thumb." These littoral bands of youthful drainage pattern include some streams which have developed extensive mature dendritic patterns on the surface of the uplands, but where they descend the slopes to the lowlands they are similar, except for volume, to the rest of the youthful drainage system.

The streams which compose the more mature dendritic patterns have acquired tributaries by the cutting back of their headwaters and by the capturing of other streams (Map 3 B). They have developed toward the ideal leaf-vein pattern, but have been forced into irregularities by the nature of the surface. Their tributaries have not developed with equal speed; one may be mature and another young. Across lake beds they may develop meanders, cut-offs and ox-bows, every indication of old age, whereas a mile upstream they may be young.



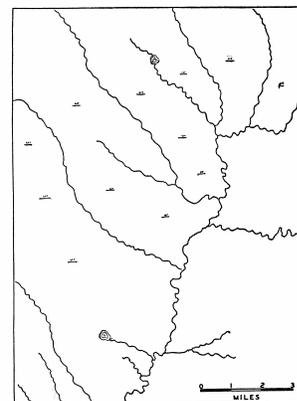
A. Youthful dendritic pattern, northern Ontonagon County



B. Mature dendritic pattern, the Saginaw River near St. Charles



C. Incomplete pattern, lake type, near Pontiac



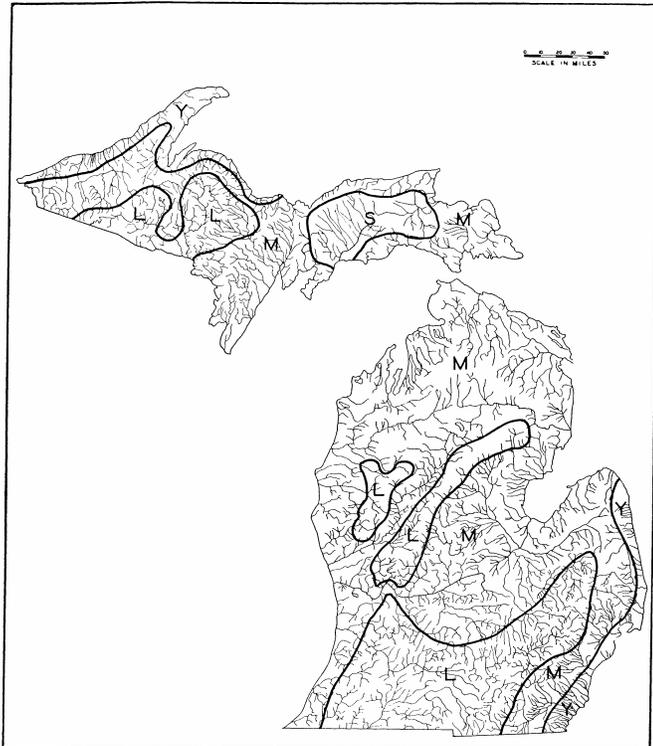
D. Incomplete pattern, swamp type, the Manistique in Schoolcraft County

MAP 3. Drainage pattern types

Though the nature of the stream valley influences the pattern but little, the irregularities of the surface affect it greatly. The Saginaw River, flowing across a fairly level lake bed, has formed in its upper course a typical mature pattern. In its lower course, however, its two principal tributaries, the Cass and the Tittabawassee, have been trapped behind moraines and bent far upstream. From this morainic bar they escape only at the gap where the Saginaw itself flows through the moraine. The Black River, in Sanilac and St. Clair counties, is limited sharply on the east by a moraine. On this side it has developed few tributaries whereas on the western side there is a fairly normal pattern. At the first break in the moraine it turns to the east and empties into the lake. Such deviations from the ideal type of the mature dendritic pattern might be repeated for many streams. In solving the intricacies of its progress each has formed a pattern more or less like the ideal model. Most of the surface of the Lower Peninsula is covered by mature dendritic drainage patterns. The Saginaw, the Grand, the Au Sable, the Manistee, the Thunder Bay, the Black and the Boardman are all of this type.

In some places the difficulties of the glaciated surface are too great to permit the streams to drain the areas completely. This results in incomplete drainage patterns. These are of two kinds: the lake type and the swamp type.

The lake type is one in which there are numerous small lakes, swamps and bogs connected by more or less permanent streams. The land between the lakes and swamps is usually dry. Such a type may be recognized by the freckled appearance which the many lakes give to a drainage map (Map 3 C). This pattern is always associated with moraines of the knob-and-basin variety. A region of this incomplete drainage covers Gogebic County along the Wisconsin boundary, parts of Iron and Baraga counties, and most of Marquette County. In the Southern Peninsula a region of this drainage occurs with the moraines which border the lowland around Saginaw Bay. This extends southward to include most of the southern boundary of the state.



MAP 4. Hydrographic regions of Michigan. L, incomplete drainage, lake type; M, mature dendritic areas; S, incomplete drainage, swamp type; F, youthful dendritic areas

The second of the incomplete drainage patterns is the swamp type. This occurs on flattish surfaces of ground moraine where the gradient is not sufficient to carry off water rapidly. Precipitation sinks into and percolates through the sandy soil instead of running off the surface. The rivers which drain areas of this type lack the power to carry off the water and are broad, shallow and slow. They are of mature dendritic pattern and meander in their channels, seeming to stagger under the load of water from an area which they cannot completely drain. They develop few tributaries and are fed from the marshy ground through which they flow. The Manistique is the best example of such a river, and its basin, most of Schoolcraft County, together with the headwaters of the Taquamenon, is a region of this pattern (Map 3 D).

The distribution of drainage-pattern types in Michigan is determined largely by the surface features of glacial deposition. The youthful dendritic pattern is found on the slopes of the uplands, and the more mature pattern on the flatter surfaces. The incomplete drainages are associated with moraines; the lake type with terminal moraines; and the swamp type with ground moraines. The accompanying map shows the areal distribution of the different types (Map 4).

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SADO ISLAND*

ROBERT BURNETT HALL

SADO ISLAND may well be called the Elba of Japan, for there lived and died the exiled Juntoku Tenno, the eighty-fourth emperor of Japan. On Sado, too, were incarcerated the beloved priest, Nichiren, and many others of less repute and nobility. Like the Korean island of Quelpart, to the south, isolation encouraged its use as a penal colony.¹

Sado lies in the Sea of Japan about 32 miles west of Niigata City and the Echigo Plain. It is a small island with an area of only 336 square miles, but its circumference, on account of an anvil-like form, is 130 miles. The island is made up of two parallel mountain ridges lying on either side of a narrow plain which separates two deep embayments. On this plain and along the extended shore line live some 111,000 people.

GENERAL HISTORICAL BACKGROUND

Distance from the main currents of Japanese life, but still greater distance from other lands, has allowed an individual cultural development, yet one which is definitely Japanese. Sado has from remotest times been a Japanese land. It is one of the classical "eight great islands of Nippon." Unlike Quelpart, which became politically and culturally Korean, and the Tsushimas, which, though politically Japanese, have been strongly affected by Korean contacts, Sado has always been Japanese in spirit and in fact.

Each period of national history has left an impress upon the island and many ancient customs have prevailed long after they have passed from the mainland. The Buddhist era has bequeathed a great array of temples and the beautiful four-storied pagoda. There is an intense religious spirit in Sado, probably stimulated by the teachings of Nichiren. Shintoism, in some of its more primitive forms, is strongly entrenched and in the galaxy of its gods there are several peculiar to Sado. The dialect of Sado is almost identical with the early Kansai or court language. Here the influence of the Emperor Juntoku and the exiled Kyoto nobles is seen. The persistence in an unchanged form has parallels in other isolated areas. The feudal period left behind the ruins of ancient castles, the limitations of political

divisions, and a strong spirit of sectionalism. In the dress of the common people many old Japanese customs show greater persistence on Sado than on the mainland. Examples of these are the blue denim trousers, bared breasts and blackened teeth of the women.

On the other hand, Sado has contributed to the total of Japanese culture. The Sado hat, the Song of Sado, the Dance of Sado, and Sado porcelain are all a part of the national culture complex.

Probably Sado is best known to the outside world for the famous gold mine of Aikawa. It is the oldest gold mine in the empire and has been worked continuously for more than three centuries. For long it dominated the life of Sado and many local festivals and customs are related to it.

A historical event of great significance was the opening of the port of Ebisu to foreign trade shortly after the Restoration.² This port became the "outport" for Niigata and still retains that function for some commodities. This gave Sado an early start in the modern period of westernization.

The origin of "Sado," as a geographical place-name, is moot. The Ainu word "satsu," implying a dried-up lagoon, has been frequently suggested. There are other Ainu place-names on the island. Ebisu, the chief port, is an example. Since the vast majority of sites of ancient Ainu settlements have been found on the edge of present diluvial terraces overlooking the central plain of recent alluvium, the word "satsu" may have a deep significance.

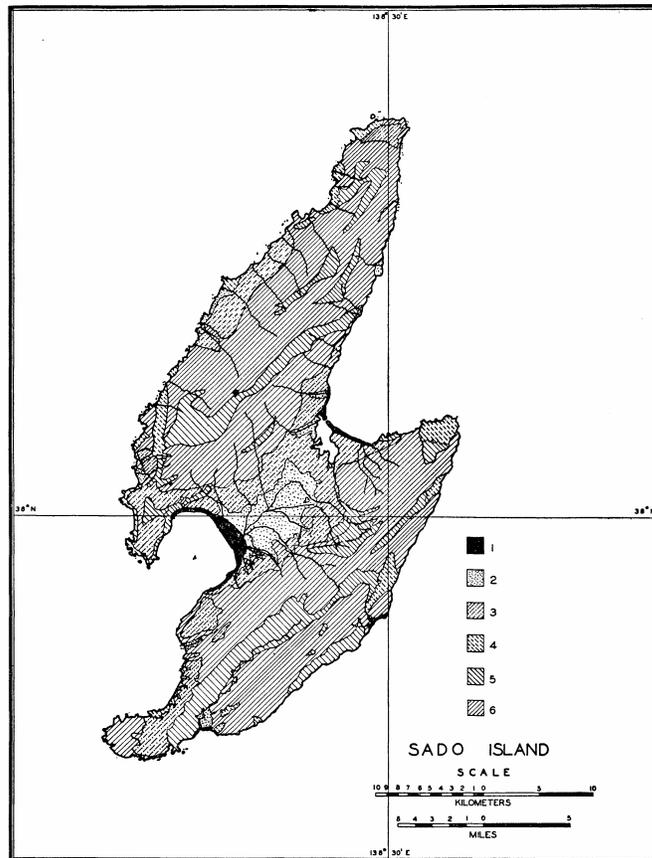
"Sato," a Japanese word, meaning "narrow gate," is believed by some to contain the origins. This might well apply to the narrow central plain which separates the two mountain systems. "Zatsuta" is claimed by others, since it was once the name of the Gun division containing the island.

GEOMORPHOLOGY

Sado is composed of two elongated, warped domes extending, as mountain ranges, in a northeast-southwest direction. Between them is inclosed a narrow depression, the central part of which is now filled with sediments (Map 15). It is interesting to note that the trend of major surface features on Sado is parallel to that of the adjacent mainland. The tertiary rocks of the folded hill belts behind the Echigo plain have been generally identified with those of the small monoclinical island of Owa just north of Sado.³ It will probably be found that at least the tertiary rocks of Sado can also be correlated with them.

The navigation charts add further evidence. It would seem that the passage between Sado and the mainland is a synclinal depression (Map 16). The two mountain masses of Sado, then, may be considered anticlines, with the intervening plain and bays occupying a synclinal

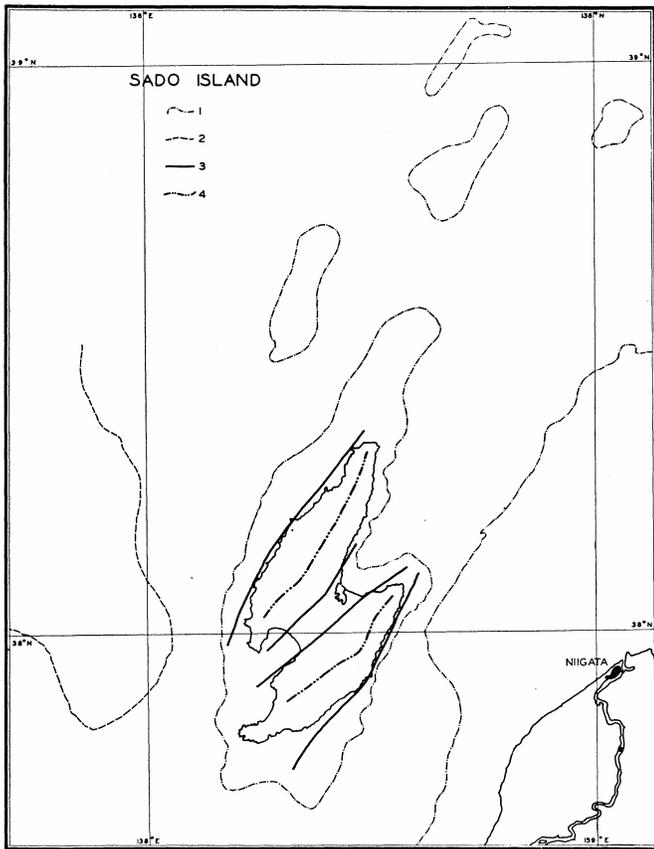
depression. However, the work which has been done in stratigraphic geology strongly indicates that the margins of both mountain masses have been dropped down by faulting. On the north and south shores of the island there is definite morphological expression, but the scarps bordering the central plain lie below sea-level and the lines of demarcation have been deeply masked by sedimentary deposits.



MAP 15. Geomorphological map of Sado Island. Explanation of symbols: 1, areas occupied by sand dunes; 2, alluvial plains; 3, diluvial terraces; 4, tertiary hills; 5, kettle-shaped tertiary hills and mountains; 6, cone-shaped hills and mountains of liparite, andesite and other minerals

The upwarping of the mountain ranges and the subsidence of the central plain are still in progress. This is revealed in a number of ways. There have been several violent earthquakes within historical times which have resulted in the uplift of new abrasion surfaces. The valleys throughout the mountain lands show several rejuvenations. In many places, a series of narrow step-terraces mark the valley sides. The alluvial fans on the mountain margins of the central plain are distinctly in a stage of youthful dissection. The rapid rate of deposition on the central plain is apparently offset by subsidence and the surface remains nearly at sea-level. Possibly the most impressive land-form development on Sado is that of marine terraces. Five levels can be recognized, which in places occur together as giant stairs leading upward from the sea. Each terrace has a distinct sea cliff at its back. Seldom is there a development of

conspicuous littoral plains. Normally, the lower terrace is composed of rather fine-textured young diluvium in which the streams have cut gorgelike valleys. The second terrace is of diluvium, generally old, and is often in a stage of early mature dissection. The three upper terraces are on tertiary shales, shaley sandstones and other rocks.



MAP 16. Sado Island. Explanation of symbols: 1, 100-fathom depth lines; 2, 1000-fathom depth lines; 3, fault lines; 4, major crest lines

In some places the diluvial terraces are not present and tertiary levels occur but slightly above sea-level. Here the streams occupy widely spaced, notched valleys. The upper tertiary terraces display a remarkable development of stepped valley sides.

The northern mountain land is the loftier and is called Ō Sado, "Great Sado." Kypokusan reaches 1,173 meters and is the culminating point of the island (Pl. XVI). Several other peaks in the vicinity exceed 950 meters, but elevation gives way rapidly in all directions. The southern system is called Ko Sado, "Little Sado," and the maximum elevation found is the crest of Daichiyama at 646 meters. In both ranges the main divide is parallel to the coast and at approximately the center of the peninsula. Both areas are characterized by two kinds of land forms. The tertiary hills and mountains are "kettle-shaped." Their crests bear extensive surfaces of low relief of a former cycle and cause a sharp topographic unconformity with the steep slopes of the present cycle. The hills and mountains of andesite

and liparite are "cone-shaped," the liparite ones conspicuously so. Neither type is characterized by flat-topped crests.

The central plain is made up of five kinds of surface forms:

- (1) A central, flattish plain of alluvium lying but slightly above sea-level and rising gradually from southwest to northeast and from the center toward the margins;
- (2) A terrace of younger diluvium, in a stage of very youthful dissection, which lies at one to two meters above the alluvial plain;
- (3) A terrace of older diluvium, in mature dissection, rising four to six meters above the alluvial level and, together with a terrace of younger diluvium, separating the alluvial plain from the adjacent uplands and forming a broad belt which extends the width of the plain west of Lake Kamo;
- (4) A youthfully dissected, intermittent fringe of alluvial fans at the infacing foot of both mountain lands; and
- (5) Sand dunes extending the width of the plain on both shores.

Lake Kamo, at the northeast end of the central plain, is separated from the sea by a long sand spit. This lake originally contained fresh water, but about thirty-seven years ago the spit was cut through by wave action and the water became salt. The opening was later enlarged in the hope of using the lake as a harbor. At present, however, only very small boats can pass under the bridge which crosses the opening.

THE CLIMATE OF THE NORTH AND SOUTH SHORES

Sado falls within the Cfa climate of the Koppen system. In general, it is characterized by the same features as the adjacent west coast of Honshu, except that temperatures are somewhat more moderate. There is the same winter maximum of precipitation and heavy snows occur.

Table I shows data on comparative rainfall for Niigata and stations on Sado Island.

Exposure to the winter monsoon on the north coast and the modifying influence of the Tsushima current on the south coast are expressed in differences in land use and natural vegetation. On the south shore oranges, figs, loquats and bamboos thrive, but they do not occur on the northern coast. Mulberry trees and accompanying sericulture are much more prevalent in the south.

TABLE I*
DATA ON COMPARATIVE RAINFALL ON SADO ISLAND

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Niigata City.....	180	131	111	105	85	131	164	122	197	171	188	234	1819
Oda (north shore)....	114	95	96	119	65	84	104	115	162	138	149	184	1425
Hamochi (south shore)	182	104	93	80	76	116	69	93	133	136	130	158	1370
Ryotyu (eastern end of central plain).....	223	168	135	148	102	189	120	129	235	182	172	313	2116
Nakaoki (western end of central plain)...	120	85	67	69	69	137	114	85	148	121	101	146	1262

Rice-planting takes place about one week later in the north. Winter dry crops on paddy land are a distinguishing feature of the rural economy of the south, but are rare in the north. The following differences were noted in the natural vegetation of the two shores:

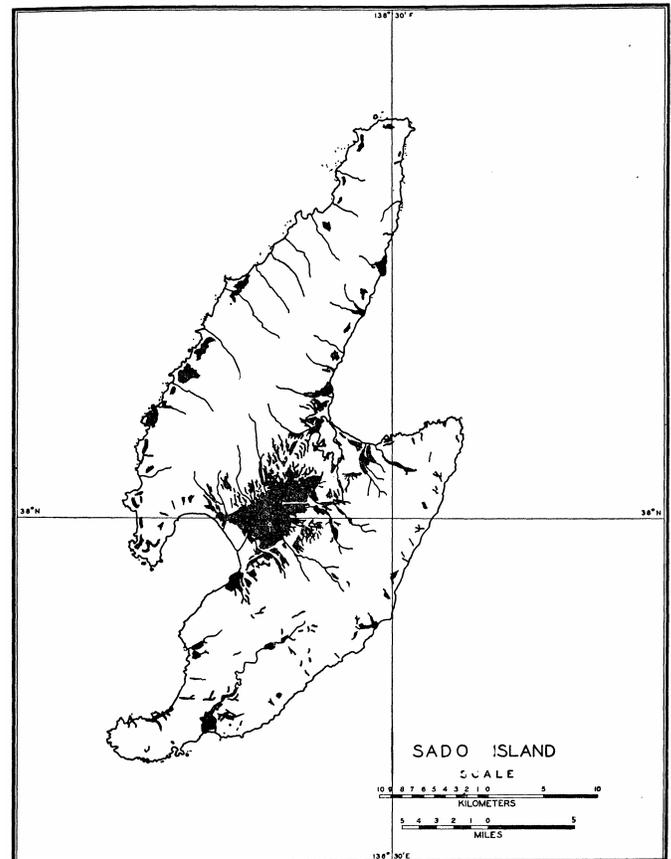
NORTH SHORE	SOUTH SHORE
I. Few or no evergreen broad-leaved trees. No live oaks, Camilla (<i>Thea japonica</i>) and <i>Pasania cuspidata</i>	Broad-leaved evergreens plentiful on lowlands, especially the live oak, Camilla (<i>Thea japonica</i>) and <i>Pasania cuspidata</i>
II. Natural and abundant growth of conifers	Scanty and probably no natural growth of conifers
III. Mixed forest of pine and deciduous broad-leaved trees	No mixed forest of this type
IV. Bamboo stunted and found only in sheltered places	Bamboo luxuriant and found everywhere
V. A kind of large-leaved dogwood (called locally Kumanomizuki) found only on lowlands	This dogwood found only on highlands
VI. The great and water oaks are found, but no small oak	The small oak is found, but no great or water oaks
VII. The small Gaya is found, but the great Gaya is not	The great Gaya is found, but the small Gaya is not

* Data for Niigata and Oda are from 1911 to 1920 and for other stations from 1914 to 1920. All data in mm. Data taken from *The Rainfall of Japan, 1911-1920*, Central Meteorological Observatory, Tokio, 1927.

THE DIFFERENT LANDSCAPES

I. The alluvial plains afford the most fertile lands of the island. These are almost invariably occupied by rice paddies (Map 17). Water for irrigation is secured in several ways. The most common method is to tap streams at the foot of the mountain and to lead the water to different parts of the plain by canals. So effectively is this done that many smaller stream beds are dry before they reach the sea. On the small alluvial plains bordering the south shore bamboo pipe lines are frequently employed. Small tanks are sometimes used, but are generally located on the adjacent terrace lands. On the central plain pumps are employed and supplement the water brought by canals. The primitive Japanese pole-and-weight pump is still found, but iron hand pumps are the most common. The water table under the plain inclines from north to south, so that the wells vary from less than 10 feet to a maximum depth of 50 feet. An insect pest, which causes a premature turning of the rice crop, inflicts an average annual loss of

20 per cent of the island's rice harvest. To combat this the rice lands bristle with miniature light poles and lines. At night the fields are aglow from the myriads of electric lights which lure the insects to pans of poisoned water. Two plantings take place on the rice lands of the central plain and the south. In the spring all land is in clover or barley. Most of the clover is turned under as green fertilizer although some is fed to cattle. Rice follows and when it is well under way rows of branch peas are planted on the dikes. The central plain is the most important rice area on the island and accounts for at least half of the total acreage. The Hamochi Plain at the western end of the south shore is second in production and, owing to an abundant water supply and higher temperatures, affords the highest yield per acre. The danger of floods and the high value of paddy lands are deterrents to roads and settlements. Dwellings are usually found on the outer edge of the adjacent terrace or other higher land. Roads likewise follow the bordering elevated lands and when compelled to cross the alluvial plain do so on top of embankments.



MAP 17. Sado Island, showing paddy rice fields

Near the western end of the central plain is an extensive area in which trails, ditches and fields all occur in a definite rectangular pattern. This is due to a cooperative project on the part of the landowners in which the old irregular and inefficient holdings were lumped together and the total was systematically redivided. Such regular patterns occur in widely scattered areas of Japan and may be due to a number of causes. One of the most

common is the cooperative redivision. Another is the arbitrary division of lands by a large landholder among his tenants. This is commonly found on the Achigo and adjacent plains. Another cause is recent reclamation of land by either the government or a large landholder. This is common on the delta plains of Honshu bordering the Sea of Japan. An ancient form is found in the Yamato Basin and adjacent areas of the Kinki District. Here the Handen or Chinese land system was introduced centuries ago and the ancient roads, ditches and property lines still persist. In Hokkaido the recent Japanese settlement has been preceded by surveys similar to those of our range and township system and the fields are thus of rectangular design. Still another occurs on Sado, where the shoestring fishing village at the western end of the central plain has annexed the sand-dune land between it and the sea. The old trails from the village led directly to the water, so that the forms of the recently established vegetable gardens are controlled by the many parallel trails. Wherever a systematic rectangular pattern is found the vista differs greatly from the ordinary Japanese patchwork landscape.

II. The diluvial terrace lands are in dry fields or in brush or forest, except where streams in the neighboring mountains can be tapped at a higher level and water made available for rice cultivation. Rice fields are rare on the second terrace because of the coarse-textured soil material, the degree of dissection and the difficulty of securing water at so high a level (Pl. XVII, Fig. 1). The more favored first terrace is frequently in paddy. The yields, however, are low, being only two fifths of the average for the island. The first terrace contains also many dwellings, irrigation ponds, vegetable gardens and roads where there are adjacent alluvial plains.

For untold centuries man has been endeavoring to enlarge the area available for paddy fields. Where diluvial terraces border alluvial plains their bases have been persistently attacked. The result is an extension of the alluvial level and a contraction and deformation of the terrace margin. Many table-like terrace remnants, which are rectangular and which are still being reduced in size, are found far out on the present alluvial plain. Boxlike valleys extend far into the terrace land and these are slowly being lengthened and broadened. At least 10 per cent of the present alluvial level of the central plain is culturally induced.

Behind Kawaharada the first diluvial terrace contains an abundant supply of bog iron, which indicates the swampy nature of this land before uplift took place. In ancient times this iron was gathered for smelting.

III. The tertiary terraces, like the diluvial ones, are in paddy rice wherever water can be secured conveniently (Pl. XVII, Fig. 2). This often eliminates the higher terraces from such use. Little dry agriculture is practiced, since the soils are very poor. The use of tertiary terrace land for paddy is also common on the island of Shikoku. In Hokkaido even peat lands have

been converted into rice fields. On the plains of the Kinki District rice has been grown year after year for centuries and little of the original fertility is left. The availability of water is a far more important factor in determining location. Fertility can be supplied artificially. In parts of Japan as much as 60 per cent of the value of the rice crop is consumed in fertilizer.

Much of the tertiary terrace surface is in brush or grass. The grazing of cattle on the higher terraces is an important industry.

IV. The tertiary hill and mountain land affords little agriculture. The narrow valley bottoms are usually in rice and the lower more gradual talus slopes offer sites for habitations and a little dry agriculture. The upper slopes are occupied by a stunted forest. Some *kwaden*, milpa or fire-field agriculture, is practiced and the making of charcoal affords an additional income to the valley dwellers. In many places there are exposed extensive areas of bed-rock which have resulted from these exploitations, and yellow-colored scars are a characteristic feature of the tertiary mountain land. In the north there are some small stands of pine and in the south bamboo is frequently found.

V. The andesite and liparite mountains are forest-covered. Only a few of the wider valley bottoms contain rice fields. A little *kwaden* is practiced, but is far less common than in the tertiary mountain country. The preparing of charcoal is of some importance, but lumbering is the first industry and furnishes an important export to the mainland. The gold mines of the island are all associated with these mountains.

VI. The sand dunes are important locations for villages and roads, since they occur near the sea and afford dry sites above the alluvial plains. Vegetable gardening has been recently introduced and has been developed in the dune lands to such a degree that it not only supplies the market on Sado, but furnishes a large export of fresh vegetables to Niigata City and other mainland markets. Pine forests occupy considerable areas of this sand land and some timber is cut.

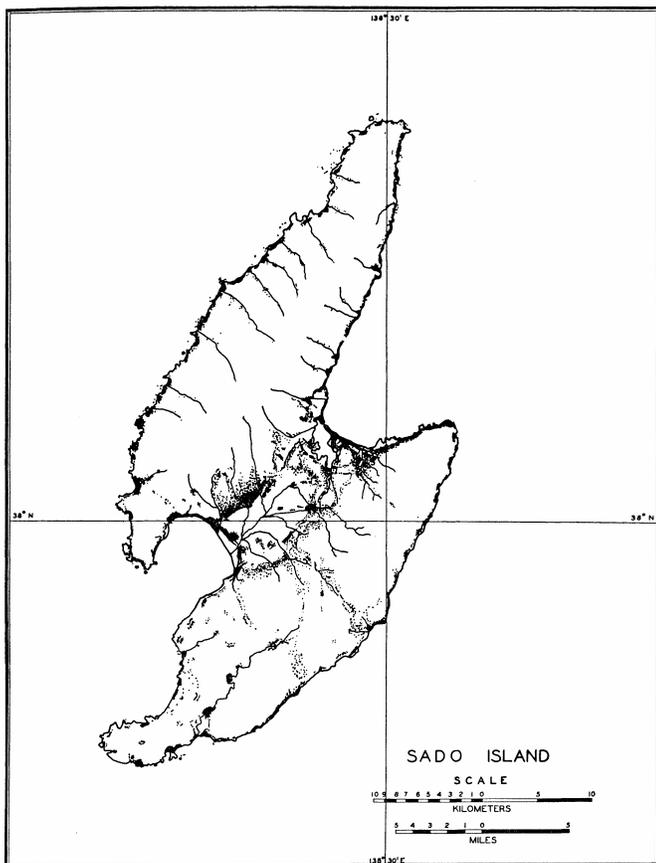
VII. The alluvial fans are chiefly waste lands, although some paddy and dry fields are found. Fans at the edge of the sea are often the sites of fishing villages.

SETTLEMENT

Half of the island's population is on the central plain. Settlement here is largely confined to the inner edge of the lower diluvium terraces (Map 18). A few compact agglomerations (*Haufendorf*) are found where important roads meet and there is a marked development of shoestring villages (*Strassendorf*) along the main highways. In general, however, the settlement pattern of this area may be described as one of dissemination approaching agglomeration. Dry garden lands separate house from house, and valley paddies and small areas

of pine forests separate clusters of houses from each other.

As in the adjacent mainland about Niigata, there is a remarkable development of *Strassendörfer*. These occur as fishing villages on the narrow strips of land between sea cliff and sea or on low narrow terraces. They are also found along the highways which follow the crests of sand dunes and on the lower slopes of narrow valleys where the bottom land is in paddy. A number exceed a mile in length and on the shore of Futami Bay a virtually unbroken double row of houses marks the road for seven miles. The larger agglomerations of Sado are all port towns. Without exception these are outgrowths of simple *Strassendörfer* and are still elongated in form although they may have developed other streets parallel to the through road.



MAP 18. Population map of Sado Island. Each dot represents six persons

The buildings of Sado are chiefly of the Echigo type.⁴ They are of heavy boards, with thick wooden shingle roofs which are weighted down by stones. Long eaves extend over the walk in front of the house to protect passers-by from sliding snow in winter. The ground plan shows a long narrow house with the ridgepole at right angles to the street when the house is one of an agglomeration or parallel when it is a lone rural dwelling (Pl. XVIII). The kitchen lies at the rear of the house and is reached by a narrow dirt-floor passage from the street. The houses of the fisher folk of the south shore have a

sickle blade mounted above the crest. The blade points southward and is believed to discourage the evil spirit of the typhoon. On the central plain there are occasional dwellings built on the Kinki plan. These tell of the past influence of political exiles from Kyoto. The several buildings are arranged about a drying yard and are connected by walls. Entrance is made through a high gate. The "shoji" and lighter structure of the houses differentiate them from other habitations.

Temples and shrines form an important part of the cultural landscape. The central plain has several fine temples, a great four-storied pagoda and many shrines. Shrines to the Sado god of fishermen, Zimpozi, are countless. On every headland, atop every coastal islet and at every other point which can be seen far at sea, miniature shrines like the temples of the ancient Mediterranean shores guide and protect the mariners. At many points primitive white or unpainted torii of natural logs mark the path from the shore to some hidden shrine. In numerous places a torii rises from the sea, some distance offshore, like the more famous torii of Miyajima.

POPULATION AND LAND

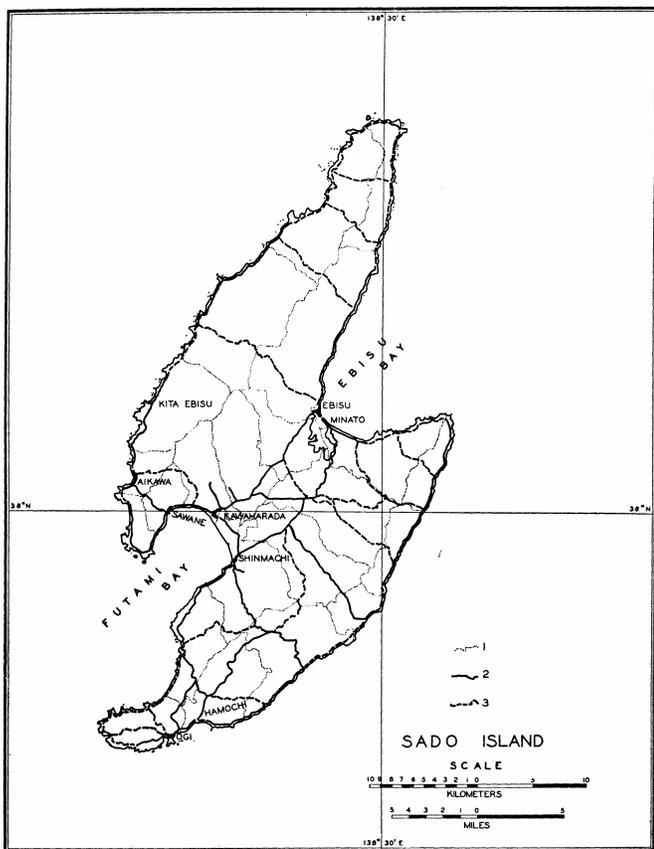
The total population residing in Sado has not changed appreciably for some years. The natural increase, which averages something over 1,200 per year, is about comparable to the trends for Japan proper as a whole. This natural increase in Sado is offset by migration. In 1928 there was a registered population of 132,379, but only 110,974 actually resided on the island,⁵ that is, 16 per cent of the total registered population had found new homes in Hokkaido, in the industrial cities of Japan and in Brazil. It is interesting to note that the more isolated sections of Sado have contributed very little to this migration. Takaishi Mura on the north shore has but 0.7 per cent of its population residing outside. Uchikaifu and Iwakubi Muras, also on the north shore, have 2.3 and 5 per cent, respectively. This is reflected in large families. The former averages 6.9 persons to the family and the latter 6.5. In Aikawa and Nishimikawa, both mining areas, the migration has been heavy. Aikawa has a registered population of 13,370, with but 7,184 residing in the town. The loss has been 46 per cent. The average family shows but 4.0 persons residing at home. Nishimikawa has lost 42.6 per cent of its population. Ogi, a port and fishing settlement, now has an excess of 125 people over the registered population (Pl. XIX, Fig. 1). This is due to stimulated economic activity resulting from recent harbor improvements and industrial development. In general, the more accessible sections have lost the greater part of their people, whereas the more isolated populations have little opportunity to get out; apparently, under the present economic system, Sado has reached a point of population saturation.

The total area of arable land in Sado is about 140,000 *cho*, of which approximately three quarters is wet rice land. The distribution of ownership, unlike that of the

adjacent areas in Honshu, is remarkably uniform. Only 21 individuals own in excess of ten *cho*, 103 own more than five *cho*, 4,016 own between three and five *tan*, 8,214 own farms of less than five *tan*.⁶ The distribution of other forms of wealth is similarly uniform and results in a homogeneous cultural landscape.

ROADS AND CARRIERS

As on typical small islands, a shore road entirely encircles the island. In places this road is improved and is now used by motor busses (Map 19). In other places, it is but a trail. Between Togi and Tochu, on the north shore, a 250-foot cliff rises above the sea (Pl. XIX, Fig. 2). Here the shore road, which for some distance has been following the shingle beach, comes to an end at high tide. At low tide one must run along the wet sand at the base of the cliff on the receding wave. Beyond this point the north coast is the most isolated and backward part of the island. Rickets, bad eyes and physical and mental deformities are the scourge of the population. Poverty and unsanitary conditions are rife. A saddle-like pass cuts the northwestern peninsula and is followed by a road which connects Aikawa and vicinity with the central plain. No other roads cross the mountains of O Sado. The lower southern mountains, however, are crossed at three points by good roads.

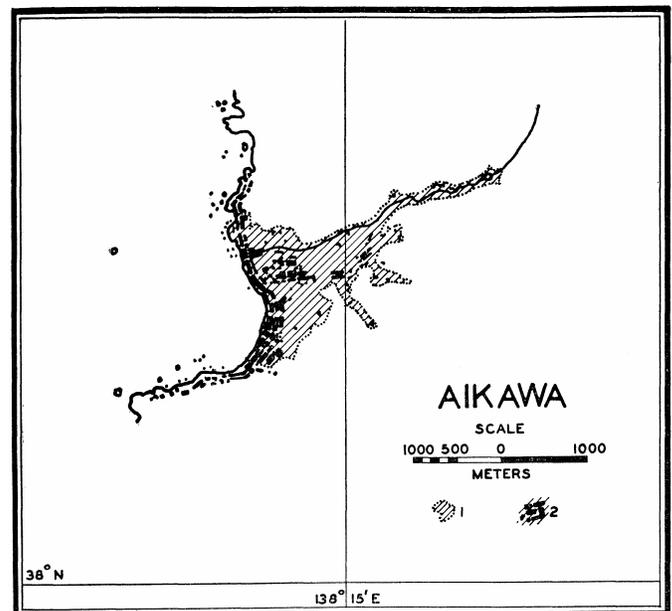


MAP 19. Political, road and location map of Sado Island. Explanation of symbols: 1, mura boundaries; 2, important roads; 3, secondary roads and trails

Cattle are the chief carriers on Sado. There are few horses and few wheeled vehicles. Human packing is more common than in most parts of the mainland. Motor busses now ply between the central plain and the coastal points which are accessible, but are employed almost exclusively for passenger traffic.

AIKAWA

The gold mines of Aikawa have brought Sado its greatest fame. The production of gold is an ancient industry of the island. The first mine discovered was the Sawanetsuruko, to the east of Aikawa, in 1542. The washing of gold sands, however, far antedated this discovery. The first mine of Aikawa was discovered in 1601 and the present mine was started in 1606. Fable has it that a lone fisherman one night saw the reflection of the moon on a nugget of gold and the discovery followed. After the opening of the present mine Aikawa enjoyed great prosperity.



MAP 20. Map of Aikawa, showing the ancient extent of the city and the present occupied area. Explanation of symbols: 1, Aikawa at the time of its greatest extent; 2, area occupied at present

The mine became the property of the Tokugawa Shoguns and provided an important income for them. Three hundred shafts were sunk and production increased rapidly; miners, artisans and the many classes of people who served the workers poured in from the mainland. By 1613 some 120,000 persons had settled in the town of Aikawa, which extended far up the valley behind the present town and even spread out over the lower terrace lands adjacent (Map 20). The peak of production was reached in 1626, after which a gradual decline took place. More effective methods of mining, coupled with a decreasing production, reduced the number of people employed and the city of Aikawa slowly shrank to its present population of 7,184. There

is a continuous cartographic record of this decline from 1694 to the present time. Remains of the ancient town may be seen on every hand. The site of ancient Ginzan Machi ("Silver Mountain Town") is readily identified. Aikawa included this town and extended from it to the sea. Temples and shrines mark the different peripheries. Compact groups of dwellings are scattered here and there over the area once occupied and are remnants of the former city. The remains of stone walls which once protected the ore warehouses may still be located.

Map 20 has been constructed from this field evidence and from the ancient maps.⁷ The maps of 1694 and 1695 show the valley to be built up solidly from the sea to Ginzan Machi, but indicate along the sea an area of occupied land narrower than that at present used for habitation.

An increased interest in the sea has accompanied the decreasing dependence upon mining. The map of 1890 shows marked widening of the occupied area along the shore, but not to the limits of the present town. According to this map there were several more remnants of the old city than are found today. A village of possibly one hundred houses is represented on the site of Ginzan Machi. The map of 1911 indicates only a dozen or so houses on that site. It also reveals a decrease in the number and size of remnants, but a continued extension of occupied land along the shore. At present, no buildings mark the site of Ginzan Machi and the shore village forms a long serpentine settlement at right angles to the major extent of the old city.

After the Restoration the mining property passed into the hands of the Meiji emperor and was turned over to the Bureau of the Interior. The opening of Japan to foreign trade brought great distress to Aikawa, since gold could be imported more cheaply than it could be produced by primitive methods. Relief was temporarily tendered by the national government and new methods of mining were introduced. In commemoration of the kindness of the Meiji emperor in that time of distress a great festival is now held annually at Aikawa. In 1896 the mine was sold to the Mitsubushi family, by whom it is still operated. For 328 years, then, there has been a continuous production of gold at Aikawa. No other gold mine in Japan can claim such a record. Eight other mines in the empire now exceed the production of Aikawa, but it is doubtful whether any can equal it in the total volume of its production. It was estimated in 1929 that there had been an average monthly production of 40,000 grams for 50 years and an average monthly production of 10,000 grams for 276 years. This would have brought the total production of gold to 57,120,000 grams by 1929. It is claimed that in the ancient days the best ores ran as high as 5,000 grams per metric ton, but now the best do not exceed 500 grams and the average seems to be about 5 grams.

At present there are two main shafts, each of which is about 1,000 feet deep. Modern machinery is employed,

although the condition of the 400 men and women miners reminds one of Dickens's description of the English coal mines. An average of 10,000 metric tons of ore is now taken out each month. It is believed that at the present increasing rate of production complete exploitation will have taken place in from 10 to 15 years. Silver and copper occur with the gold. Silver now exceeds the gold fifteen times in volume; about 700 kilograms of copper are produced each month. A hydrous iron clay occurs with the ores and forms the basis of the Aikawa porcelain industry. The refining of gold and silver is done at the mine, although some of the higher grade amalgamations are shipped to Osaka. The better copper goes to Naoshima in Okayama Prefecture, but the very low grades are processed locally.

INDUSTRY AND EXPORT TRADE

The most valuable production of Sado, like that of Japan proper, is rice. The average annual production is about 170,000 *koku*,⁸ of which approximately 50,000 is exported. The chief dry-land crop is barley, which is almost exclusively a sustenance crop. Vegetables are grown on the dune lands for export to Niigata. Very few mulberry trees are grown and only six hundred families are engaged in sericulture. The rearing of cattle is of considerable importance and Sado is famous for its beef in the markets of western Honshu. The forests produce lumber and charcoal for export. In these activities 65,000 *cho* of land are employed.

Next to the combined productions of the land, fishing produces the most wealth. A variety of fishes and large quantities of seaweed are exported to the mainland.

Owing to its offshore reefs, Tasha is famous for tai or sea bream, the favorite fish of all Japanese. Kita-Ebisu is the chief center for edible seaweeds. The south shore is noted for its cuttlefish and ear shells. Strings of these fish may be seen drying on the front of every fisherman's house; they are an important article of export. Octopus is a noted product of Sado Island. The sea floor off the north shore is rocky, and fishing is largely by line and spear. Many kinds of fishes are secured for local consumption and export. Sado fish dealers are seen in all the markets of Niigata Prefecture.

There are few manufacturing industries of importance in Sado. Bamboo articles, chiefly baskets and vases, are produced by home industry all along the south shore. A few coppersmiths are still to be found in Aikawa, but their work is poor. Sado porcelain is made in Aikawa, though there is little export.

There are five small hydro-electric plants, and few villages are so isolated that they do not have electric lights.

The preparation of *miso*, a base for soup, is the most significant manufacturing industry. At Hamochi two factories each employ about two hundred workers and have an annual production of 70,000 to 80,000 *kwan*⁹

barrels. The industry is located on Sado chiefly because of cheap labor. Seventy-five *sen* per day seems to be the average wage for all classes of workers. The raw materials are all imported. The beans come from Chosen, the rice comes from the northern part of the Echigo Plain, and the salt from Bingo on the Inland Sea. Exports go chiefly to Tokyo, Saghalin and Hokkaido. There are two other smaller *miso* factories on the island, one at Ōishi and one at Mano. There are also five or six small *shoya* (i.e. soy) factories, of which two are at Hamochi.

CONCLUSIONS

Sado is much like other small islands of similar location in that its culture, although a part of the general mainland complex, bears a definite local stamp. Throughout the island there is a marked uniformity in language, customs and material culture. This, together with a uniform distribution of wealth, has led to homogeneity in houses, vehicles, fields and in fact in all forms of the cultural landscape.

It is apparent from population trends and the general standard of living that Sado has reached a saturation point in regard to population. Unless some unexpected cultural rejuvenation takes place Sado will continue to be an area of migration and relatively low living standard.

UNIVERSITY OF MICHIGAN

* Social Science Research Council Fellow for research in human geography in the Japanese Empire. This monograph constitutes part of one of the four regional studies made in Japan proper in 1929.

¹ Hall, R. B., "Quelpart Island and Its People," *Geog. Rev.*, 16 : 60-61. 1926.

² *History of the Niigata Tariff Office, Yokohama; Collectors' Report of Niigata and Ebisu, Niigata, 1867; Description of Sado, Sado Gun Office, 1922.* (In Japanese.)

³ Unpublished notes and materials of Professor Tokoshige, Niigata Koto Gakko.

⁴ Hall, R. B., "Some Rural Settlement Forms in Japan," *Geog. Rev.*, 21: 110-117.

⁵ Statistical data supplied by the Sado Subprefectural Office.

⁶ One *cho* = 2.45 acres; one *tan* = 0.245 acre.

⁷ Collection of maps of the Sado Mine office, Aikawa.

⁸ One *koku* = 5.11 bushels.

⁹ One *kwan* = 8.26 lbs. (avoir.).

PLATE XVI



Kmpokusan and the Ō Sado range from Kanazawa on the central plain. Note the abrupt lower slopes facing the plain. Picture taken April 10, 1930.

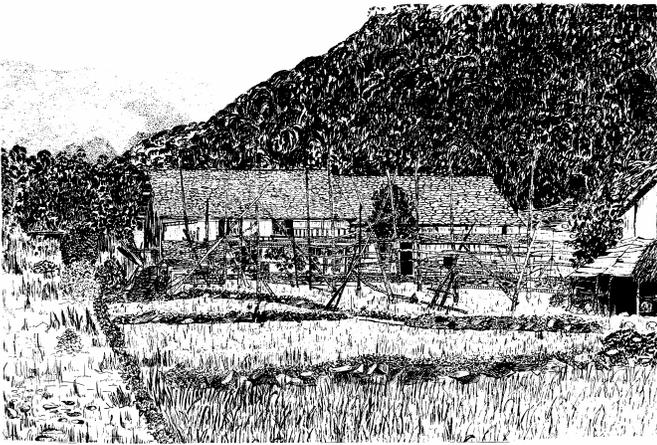
PLATE XVII



FIG. 1. Rice on the lower diluvial terrace north of Kita-Ebisu. The upper terrace also is of diluvium, but is chiefly in brush



FIG. 2. A tertiary terrace in paddy fields on the far northern coast. Note the youthful valley in the foreground



An isolated rural habitation of a type common on Sado Island and the Echigo Plain of Honshu. Many drying racks are in front of the house and on the dikes



FIG. 1. Fisher folk in the harbor of Ogi



FIG. 2. A typical fishing village of the north shore. Along the beach are many small boats and the piles of drying seaweed. Cleared patches of terrace land can be seen in the background

LAND INVENTORY FOR RURAL PLANNING IN ALGER COUNTY, MICHIGAN

LEE ROY A. SCHOENMANN

IN AN article on "Theory and Practice in Land Classification" in *The Journal of Land and Public Utility Economics*, 1:160-175, P. S. Lovejoy writes as follows:

The new period in our land affairs is now well opened. It will be characterized by deliberate and more and more competent inventory of lands and of factors which limit or affect the use of land.

Moreover, it will, I believe, become increasingly apparent that a land inventory is one thing, that land classification and planning for use is another thing, and that putting the plans into practice — the political science or engineering of land utilization — is still a different thing. The three operations are quite distinct; yet all are necessary to achieve intelligent land utilization.

The inventory proper in the case of land should be like any business inventory, as, for example, in the physical valuation of the railroads; it should "express no opinions, offer no advice, and make no plans," but it should assemble all the essential data requisite to the formulation of adequate and workable plans for the utilization involved.

Land classification, on the other hand, involves the making of specific plans for the lands reported upon by the inventory on the basis of the facts found by the inventory. Classification and land planning go hand in hand, for classification is essentially purposive; it looks to the attainment of some end and hence includes planning.

On the basis of the inventory and the classification, there remains the difficult task of transforming the plans into actualities — of putting the theories into practice — or, to phrase it another way, of getting policies in operation.

Recognizing the inventory as a prerequisite to classification and planning, the Michigan Land Economic Survey has proceeded to "inventory" the present-day character, the status of use and the economic environment of the lands, forests and waters in fourteen counties of northern Michigan. Within this area of 6,500,000 acres a great number of private interests and public agencies are now using some of the data that this Survey has assembled for directing their attention to particular affairs or particular lands.

This use of the inventory data is in reality a type of planning based on the "facts found by the inventory," but it is at the same time an uncoordinated and piecemeal use of only the most obvious facts or of those that bear solely on an immediate problem, and thereby falls far short of the inventory's full application and value. So far, however, no person or agency has offered or attempted to do more. Meanwhile, the Survey has held to its adopted policy, to "express no opinions, offer no advice, and make no plans," but concerns itself solely with the further extension of the inventory.

This paper is, therefore, an attempt to formulate a land-utilization plan, as proposed by Ely, Gray, James and

others, for the lands and associated resources of Alger County, an area of more than a half-million acres, on the basis of the facts found by the Michigan Survey's land inventory. The inference is that, when the character of these lands, their physical and economic environment, and the history and status of their use are known, then their definite assignment to the one of several possible uses which is in the highest degree of harmony with their character and environment is not only possible but quite easily obvious.

THE INVENTORY

The necessarily long and tedious description of the methods used in making, checking and assembling the inventory may be omitted, since this information is available from other sources.¹

It will suffice to point out that a standardized technic is followed, with recognized methods of classification which permit the identification and correlation of similar characteristics or values even when they occur in widely separated units of varying magnitude.

A brief review of the variety of the data that the inventory assembles is presented here in order to give the facts on which the utilization plan has been rested:

Climate. — The records of the U. S. Weather Bureau are assembled. The sections of the *Atlas of American Agriculture* that deal with climate are consulted. During the course of the Survey evidence is sought in the field of the effect of rainfall, snowfall, hail, extremes of temperature, frost, growing season, wind velocity, etc., on the natural vegetation and farm crops.

Geology and physiography. — The geological inventory defines the nature and extent of the glacial and consolidated rock formations in greater detail than they were formerly known and points out their possible commercial utility. The geological inventory not only pictures the physiography of the area, but also identifies the causative agencies. It includes an analysis of the mineralogical character of the subterranean waters associated with each important formation.

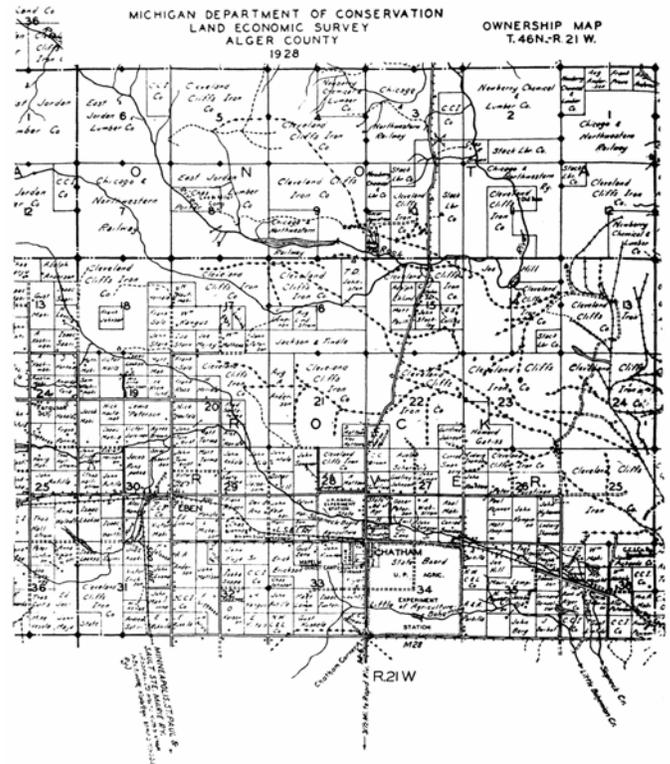
Lakes and streams. — The mapping of the drainage systems includes all permanent streams and the major intermittent drain-ways. Records taken on the main streams and their feeders tally width, depth, rate of flow, temperature, color, degree of flooding, character of the bottom, and the presence or absence of aquatic vegetation, boulders, logs, etc.

The sinuous outline of all lakes, ponds and flowage areas is delineated and the principal bodies of water are mapped in greater detail on large-scale maps to picture the soil character of the lake bottom, the nature and extent of the aquatic vegetation, and the limits of the shoal and deep water.²

Soil and "lay of the land." — The soil conditions are identified according to the standard system of

classification recently adopted by the U. S. Bureau of Chemistry and Soils. All portions of the area are covered with equal intensity, so that the resulting soil map (Map 30) indicates the location and extent of each individual type area of five acres or more. The soil map, therefore, automatically defines soil character, stoniness, degree of natural drainage, natural fertility, durability and adaptation of the land for crops, forests and other vegetation.

Where topographic maps are not available, the "lay of the land" is mapped into five classes that range from level to steep-sloping.



MAP 29. Ownership map, Alger County, Michigan

Forest growth, other natural vegetation and land use. — The farm-forest map (Map 31), delimits the areas occupied by cities and villages, the lands used for farm crops, pastures or orchards, the apparently idle farm land, the extent of the forest growth and the dominant vegetation on the treeless areas. The forest growth is classified into types on the basis of the composition of the stand (associated species) and further subdivided for density and size, so that the areas occupied by mature, fully stocked stands of pine, hardwoods and swamp conifers are clearly distinguished from those with immature and understocked second growth.

Culture.—The "man-made improvements" in roads, railroads, cities, villages, drains, power dams and transmission lines, mines and quarries, industrial plants, sawmills, logging camps, farmsteads, resort hotels, summer cottages, hunting and fishing cabins, churches, schools and other public buildings, etc., are shown on the "base map." The base maps are "built" on a transfer

of the U. S. Land Office plats, as these cultural features and the lakes and streams are encountered during the progress of each day's work. Land ownership, soil types, lay of the land and the items carried by the farm-forest map are added to this common base map. (See Maps 29-31.)

Wild life. — The variety and prevalence of the principal game birds and animals, the fur bearers and certain predators is appraised by a tally of the number seen during the progress of the Survey and the covert or habitat in which they were sighted.

Water power. — The water-power inventory reports on the developed water-power projects and the undeveloped power sites of the major streams. It furnishes a statement of the approximate amount of power that can be developed at each site and makes an estimate of the cost of development.

Economic study. — The history of settlement and of the successive steps of exploitation and development that the area has experienced is gathered from records and interviews.

The present distribution of habitations (permanent and seasonal) is charted in conjunction with the trade areas tributary to the several trading and shipping points (Map 33) in order to emphasize the extent to which human occupation has localized itself and to define the limits of the area within which each trading and shipping point has a dominant influence and a competitive advantage.

The major transportation routes indicate the relative accessibility of the different parts of the area to markets and shipping and trading centers (Map 32).

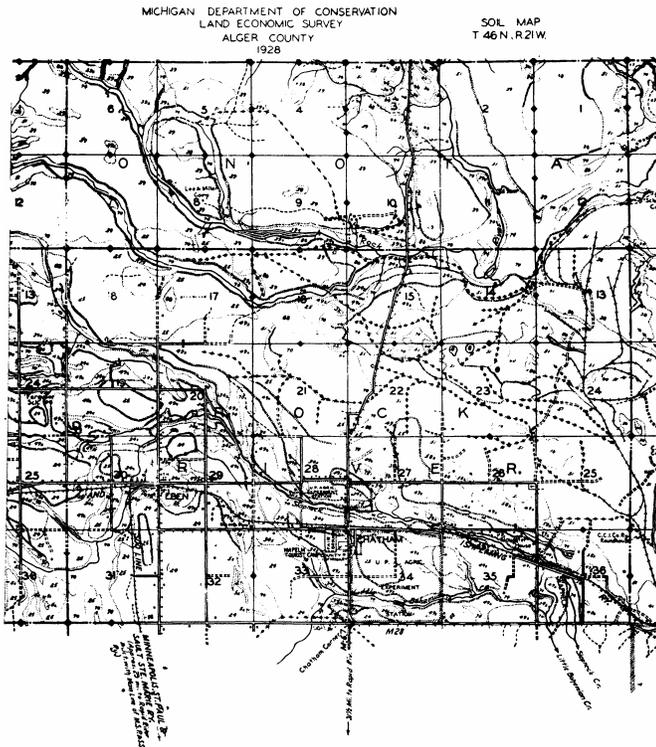
The land-ownership map (Map 29) shows who owns the unplatted land outside the cities and resort subdivisions. It serves to define the dispersion of ownership by the size of holdings and is the basis for the equally or more significant "intent-in-ownership" classification (Map 36), which allows the grouping of scattered and contiguous parcels that are held by a great number of individual owners, into intent in ownership classes, i.e. farming, timber, recreation, mining, water power, speculation, etc., so that the lands in each class may be treated as a single unit. This is possible, since all the owners in any single class will have a substantially common interest in their individual holdings.

The charting of assessed valuation (Map 37) expresses the local appreciation of the existence of resources of high actual or speculative value.

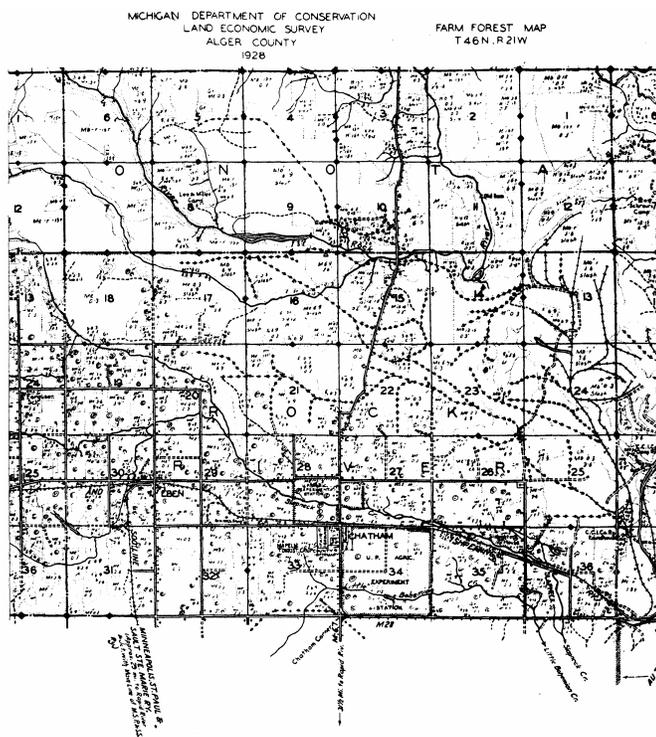
The charting of the localization and degree of tax delinquency in conjunction with the dispersion of the lands already in state ownership (Map 38) is significant in indicating the particular lands where actual or apparent values are shrinking in the owners' estimation and where public ownership is likely to expand in the near future through the further accumulation of tax delinquency.³

MAKING THE PLAN

The first step in the preparation of the utilization plan (Map 39) consists in making a thorough study and digest of the full detail of the inventory data and their environmental controls. Correlation of these facts with



MAP. 30. Soil map, Alger County, Michigan



MAP 31. Farm-forest map, Alger County, Michigan

the history of past use, present status of use, and the position of existing use (or lack of use) in its normal trend of progression will identify certain combinations of character and environment as having proved either suitable or unsuitable for particular types of utilization through the evidence of "trial and error" with such utilization. It is not necessary that these correlations rest solely on the results that have been obtained within the area under consideration, since the inventory identifies similar characteristics and values in widely separated units. In fact some of these correlations are so obvious that they need no further support. For example:

Private forestry will not seek fire-cleared areas of dry sandy pine land. Such lands are being discarded to public ownership except when they possess associated qualities that give them a value for uses other than forestry.

Public forestry (national and state) seeks low-value forest lands which require considerable initial outlays for rejuvenation and a long wait for returns.

The deer-yard type of state-owned wild-life refuge and public hunting ground requires a special and peculiar style of landscape (combination of cover, water and terrain) and may still fail to fulfill its purpose if too closely associated with developed farm lands or if blocked off from expansive areas of wild lands by farm development.

State parks that embrace any considerable acreage find their justification in making some area of outstanding natural attraction available for public use.

County parks have a high utility only when they combine a well-drained forested site with water frontage and bathing facilities conveniently accessible to the county's most thickly populated areas, or when they preserve some historical site or some unusual natural feature and make it available for public use or appreciation. The summer-cottage type of recreational development seeks access to lake frontage and is enhanced in value and permanence by good roads.

The development of camps for hunting and fishing, on the other hand, depends to a considerable degree on an isolation that permits the secluded enjoyment of these forms of recreation. It finds, therefore, a greater permanence and value in the more remote portions of wilderness areas that are not too easily accessible.

Agricultural development has consistently failed to maintain itself on any considerable area of marsh land or low-grade sandy land. Only the adequately drained, productive, high lime loam and clay loam soils that possess favorable surface features and location have attracted permanent farm development or seem likely to invite its further expansion in the near future.

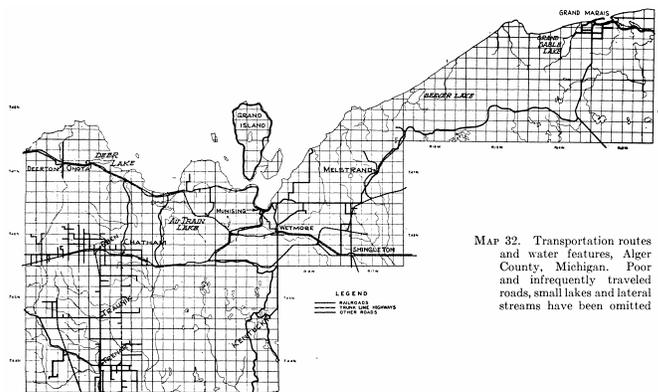
These generalities have been so commonly and frequently repeated by correlation of the inventory data in the fourteen counties so far completed that they may be axiomatically accepted for northern Michigan. They

are resubstantiated by close study of the inventory data of Alger County.

One thing more now remains to be done before undertaking the assignment of particular areas to certain uses, that is, to reduce the maze of detailed data shown on the soil map (Map 30) and the farm-forest map (Map 31) to the more simple terms of the natural-district map 4 (Map 34) and the land-use and cover map (Map 35), so that the dominant characteristics of the different parts of the county will be more easily apparent.

We now have a set of maps (Maps 32-38) on which the details of the inventory findings for physiography, soil, natural drainage, adaption to natural and cultivated vegetation, condition of forestation, water features, distribution of habitation, transportation, local markets, land use, intent-in-land ownership, valuation, trend toward land ownership, etc., have been summarized. By keeping in mind the formerly recited axioms and the policies of the agencies administering public land affairs (national forests, state forests, parks and wild-life refuges) we are ready to start constructing the land-utilization plan.

There are nine natural districts, each possessing a marked unity and individuality of character throughout its entire extent that places it in sharp contrast to each of the eight other natural districts. There are eight possible types of land utilization, each capable of employing considerable acreages of land, namely, forests, wild-life propagation, recreation, parks, agriculture, water power, mining, cities and towns. The problem is to allocate these eight possible, uses over the nine natural districts in such manner and extent that every part of the entire area will be used for the purpose to which it is obviously best suited by natural character and environment, while keeping in mind that these uses must be able to maintain themselves in competition with similar uses elsewhere. We may not expect that any one of these possible uses will survive such foreign competition, or even local competition, by the other seven possible uses, except as it may find an unusually favorable natural setting and environment here.



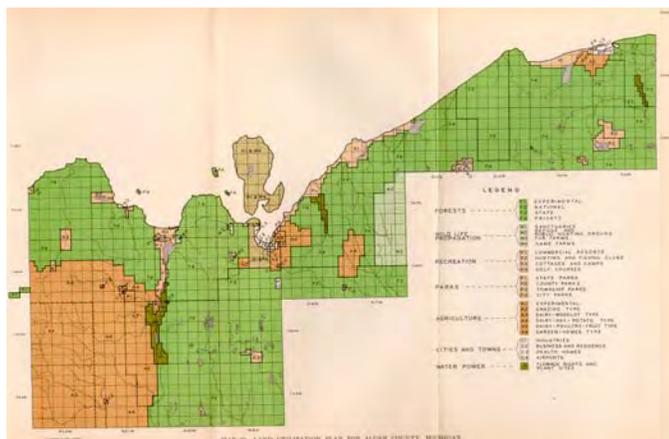
MAP 32. Transportation routes and water features, Alger County, Michigan. Poor and infrequently traveled roads, small lakes and lateral streams have been omitted

[MAP 32]

First, the intent-in-ownership classification (Map 36) is compared with the natural-district map (Map 34) and the land-use and cover map (Map 35). The object of this comparison is to determine where, if at all, the intent in ownership of the present owners is in harmony with the natural conditions. Where the intended use is obviously the correct use, it is at once checked into the utilization plan. As soon as discordant or uncommon combinations appear, the other sources of information and the more detailed data are consulted to establish the history of the use that the owner has in mind for the given conditions, or in the event of non-use, then to establish what particular use has proved most suitable by experience for the given conditions under similar environment. General limits and boundaries are set on the basis of the generalized data. Refinement and precision are then added with the assistance of the detailed data.

FORESTS

From the map of intent in ownership (Map 36) we find that practically all the land with mature forest growth is held for its timber value. The ownership map (Map 29) reveals that these lands are still in the hands of loggers and lumber companies. Their intent in ownership is forestry, at least for the present and until the growing forest crop can be harvested. These owners, as a class, contend that under present systems of real-estate taxation their interest in forest production on their holdings is limited to the harvesting of the present mature forest crop and that they are being forced into an operating policy of "cut, junk and jump," which is throwing cut-over lands into tax delinquency at an alarming rate.



MAP 39. LAND UTILIZATION PLAN FOR ALGER COUNTY, MICHIGAN

Forest interests, both private and public, declare that this policy is contrary to the public welfare because it prevents the private owner of forest land from conducting his operations in accordance with sound conservation principles which would assure to forestry the continuous use of lands best suited to it. They promise that under equitable taxation they will devote to

continuous forest production considerable areas of land that are "producing or are suitable for the production of forest products."

The present legislature (1931) is considering a forest taxation bill⁵ that is intended to provide the desired tax reform. If it is enacted into a statute, we may assume that it would at least apply to those lands that are sufficiently well stocked with mature and second-growth forest to warrant their receiving the benefits of this Act. Such lands would then be made available for continuous forest use except where their character and environment might justify some other more promising use. The bill also proposes that the lands that receive the benefits of the Act shall be open to the public for hunting and fishing, thus guaranteeing their availability for these forms of recreation coincident with their forest use. These two uses, private forestry and the hunting-fishing type of recreation, are mutually supporting. The former, by keeping the areas clothed with forest cover, will help to maintain a suitable habitat for game and fish which will give value to isolated locations for cabin sites.

Study of the map of intent in ownership (Map 36) indicates that timber production is the most general and widespread intent in ownership. It quite completely covers the areas with mature forest growth (Map 35), occupies a considerable part of the second-growth forest area and even extends into the open wild lands, marshes and bogs. Reference to the natural-district map (Map 34) would seem to indicate that these owners are hopeful of keeping almost every kind of land in forest production except the sand dunes in the northeastern part of the county. A somewhat better definition of that intention is obtained, however, by referring also to the tax-delinquency map (Map 38). It reveals that their intention has been weakened by an accumulation of tax delinquency wherever Districts G (sandy pine plains) and H (swamp) of the natural-district map coincide with the open wild land and the marshes and bogs of the cover and land-use map. In fact, in these situations considerable areas have already reverted to state ownership and others are fast approaching it through accumulating delinquency. Closer attention shows that even in the areas of second-growth forest delinquency of one, two and three years is quite common. In those localities where such conditions of delinquency mesh in checkerboard fashion with neighboring blocks of mature forest — high assessed value — no delinquency, the effect of the so-called "cut-junk-jump policy," is plainly revealed, as, for instance, in T. 47 N., R. 17 W., and in T. 45 N., R. 22 W., where under recent and still active logging operations the cut-over lands have been allowed to go tax-delinquent as soon as the timber is removed.

Experimental. — The experimental forest of the Lakes States Forest Experiment Station is located in Marquette County on two half-section tracts that adjoin the west line of Alger County. The results of the investigations in forest management and forest economics that are being

carried on here will be a guide to both public and private forestry in Alger County.

National forests. — The recently established Hiawatha National Forest extends into the south-central part of Alger County. The official boundaries of this national forest inclose a considerable area of second-growth forest and open wild land. Logging operators are actively engaged in cutting the remaining stands of mature forest from the private lands that have not yet been acquired by the Government.

This unit of the national forest contains a large number of lakes and streams which give it a high recreational value that will be maintained and enhanced by management of the area as a national forest. In the utilization plan the limits of the national forest have been extended beyond the present official boundaries to include a larger acreage of similar character.

State forests. — The Lake Superior State Forest, which joins the east side of Alger County, might well be extended westward to Grand Marais to include the eastern part of T. 49 N., R. 13 W., where cut-over land, open wild land, high delinquency and accumulating public ownership coincide. This area is a region of sand dunes and sandy lake bed soils. The location and the character of the soils do not invite agricultural use or private forestry. The young forest growth that has been able to reestablish itself on these sandy cut-over and burned-over lands is so scanty and of so inferior a quality that considerable forest planting will be required to obtain a satisfactory stand of forest growth.

Similar conditions prevail over an area of about thirty-six square miles in T. 48 and 49 N., R. 15 W. This area is locally known as "The White Rat Plains." Here fully one third of the land has already reverted to state ownership. This block of sandy, low-grade forest land might well be brought under management as an outlying part of some organized state forest. Like the area east of Grand Marais, it requires a large initial outlay to reestablish a satisfactory forest cover and a long wait for returns on the investment, a condition that public forestation is better prepared to undertake than private forestry.

Private forests. — The area selected for forests under private enterprise includes most of the remaining stands of mature forest. These timber stands of course cannot all be cut in the very near future; therefore the lands that they occupy will not soon become even potentially available for any other use. The associated areas of second-growth forest are mainly fair to good stands of young or advanced hardwood and swamp conifer growth. Open wild land, marshes, bogs and other low-grade forest growth are present throughout the mature and second-growth forest, but only on acreage so scattered and limited that it would normally be absorbed in the management of a considerable area for forest production. For forestry purposes the soils would class as fresh loams, sandy loams and loamy sands. The latter are level hardwood lands that experience has

shown to be just too light to sustain northern Michigan agriculture. The others are stony, rolling and hilly or imperfectly drained, qualities which do not seriously affect their forest production, but which render them less suitable for agriculture.

The area selected for private forests embraces the land and forest conditions that prompted the Rushton-Coates Act.

WILD-LIFE PROPAGATION

Sanctuaries. — All the public parks of course automatically became wild-life sanctuaries in which hunting and trapping are prohibited except as human enjoyment of these areas may demand the elimination or curtailment of certain undesirable species by authorized officers or agencies.

The "sanctuary" nature of the large area of city park surrounding the city of Munising deserves some special mention. This area has cover, water and terrain that are well suited to habitation by deer, beaver, ruffed grouse and many other interesting animals and birds. Their abundant presence will prove to be an appealing attraction to tourists, summer visitors and permanent residents.

Refuge and public hunting ground. — A block of twenty-four square miles in the eastern part of T. 46 and 47 N., R. 17 W., has been assigned to this use. It is the western extension of the state's Cusino Deeryard Purchase Area. This area has been examined by the Game Division of the Department of Conservation and is classed as suitable for the purpose. The lands on which the greatest winter concentration of deer occurs are located partly in this tract, but mainly just to the east in Schoolcraft County. Most of the Alger County lands will go to make up the zone of public hunting ground that is to surround the central refuge area within which no public hunting or trapping will be allowed.

Fur farms. — The streams, marshes and small inland lakes offer many locations that are suitable for fur farms where beaver and muskrats can be raised in captivity for their pelts. One such farm has been located a few miles west of Munising in T. 47 N., R. 19 W., along Bay Furnace Creek. A prospective location is designated just northeast of Au Train Lake on the line between T. 46 and 47 N., R. 20 W. Close inspection of the detailed maps showing water features, forest growth and soil conditions will easily reveal a dozen or more equally suitable tracts.

Native beaver are becoming quite plentiful through the wilderness areas; if unmolested they do not seem averse to occupying locations with suitable water and food supplies, even within the farming sections. In fact, a small colony is now established in the southeast part of the Agricultural Experiment Station Farm

Game farms. — The owners of Grand Island have closed this area to public hunting and are giving

attention to game propagation, notably deer and elk. This island constitutes a type of "game farm" on which the hunting privileges are commercialized by the owners in connection with their control of the recreational facilities.

RECREATION

Commercial resorts. — The only pretentious resort, other than the hotels at Munising and Grand Marais, where the public may obtain accommodations and enjoy the associated recreational facilities is located on Grand Island. The guests at the lodge on Grand Island have the privilege of enjoying the advantages and attractions of the entire island.

Hunting and fishing clubs. — Six hunting and fishing clubs have long been established in the county — Peter White Club, Deer Lake Club, Doe Lake Club, Cherokee Club, Newton Club and Birmingham Club — and nearly all of them own or have access to lands that provide special hunting and fishing privileges. The areas that have been assigned to this use cover the lands that are required for and are suited to the perpetuation of such privileges for the clubs.

At least as many more tracts suitable for club ownership, where lake and stream fishing are combined with good deer and grouse cover, are available within the areas set aside for national and private forests.

Cottages and camps. — The four areas assigned to cottages and camps were selected because they have already attracted a considerable amount of the summer-cottage type of recreational development. They all give access to fishing and bathing, have ample areas of unoccupied well-drained sandy land for additional cottage sites and sufficient second-growth forest for fair to good shade. Some of the cottages within these areas are also used by hunting parties during the open season for deer.

The symbols indicating summer cottages and hunting cabins that are scattered through the lower-central and upper right-hand parts of the area shown on Map 33 are nearly all maintained for the combined purpose of outing, fishing and hunting. Very few of these control much more land than the small acreage or lot needed for the cabin site. Though this scattered type of individual recreational development usually does not build up high real estate values, like those of the more congested lake shore development, it does, however, bring a considerable volume of trade and business to the county. It seems likely that private, state and national forestry will encourage the further development of this type of use by preserving the fish and game habitat that it seeks and by keeping a large area of suitable territory open to public use.

Golf courses. — This type of use will occupy only very small areas, but it is important in order to provide a full program of recreational facilities. Two especially well-

suited tracts are designated near the county's principal points of tourist concentration, one near Munising and another at Grand Marais, where the courses will be open to the permanent residents.

PARKS

State parks. — The most extensive state park area has been assigned to the "Pictured Rocks" shore line of Lake Superior which extends from Munising to Beaver Lake. This tremendous sweep of rock-bound shore line is one of Michigan's impressive landscape features. Miles of varicolored sandstone cliffs, with wave-worn caves at their bases, rise over one hundred feet above the lake's surface. The blue-green lake at their base and the forest-mantled crest above provide an unusual setting. Boats can make safe landings only on the short stretches of sand beach at the mouths of the rivers where the cliffs recede inland to wall the gorgelike valleys of streams. The landward boundary of the park area has been extended inland from the Superior shore along these river valleys for a sufficient distance above their mouths to include several beautiful cascades and a suitable forest setting that should be preserved in its undisturbed wilderness character.

The "Pictured Rocks" end about a mile northwest of Beaver Lake, but the park area has been extended to give access to the safe anchorage at the outlet of Beaver Lake and to include the excellent bathing beach which extends along the northwest side of that inland body of water.

A second state park area has been outlined to cover the Grand Sable Banks that lie just west of Grand Marais. This is Lake Superior's most expansive shore area of barren traveling sand dunes, whose desert-like appearance is a unique landscape feature in Michigan. Here an interesting geological battle is being waged by the landward march of the dunes, which are burying the forest, encroaching on Grand Sable Lake and threatening to block the stream that flows from that lake to Lake Superior. If the dunes should close this stream its beautiful Sable Falls will be destroyed and Grand Sable Lake will be forced to seek an outlet by draining southwestward to the headwaters of the Hurricane River. Practically the entire area that would be covered by the Grand Sable Banks Park is already in public ownership. Only a relatively small additional acreage would need to be added to acquire camping sites and water frontage on Grand Sable Lake.

The eleven "forties" of state-owned land just north of Au Train Lake should be designated as a park area open to public use for camping. This tract is partly swamp and partly well-drained sandy upland. The upland portions give access to the river that flows out of Au Train Lake. They are forested sufficiently to provide shady camp sites. Recent expansion of the cottage type of recreational development in this vicinity is fast restricting the public's access to water frontage camp sites. Both