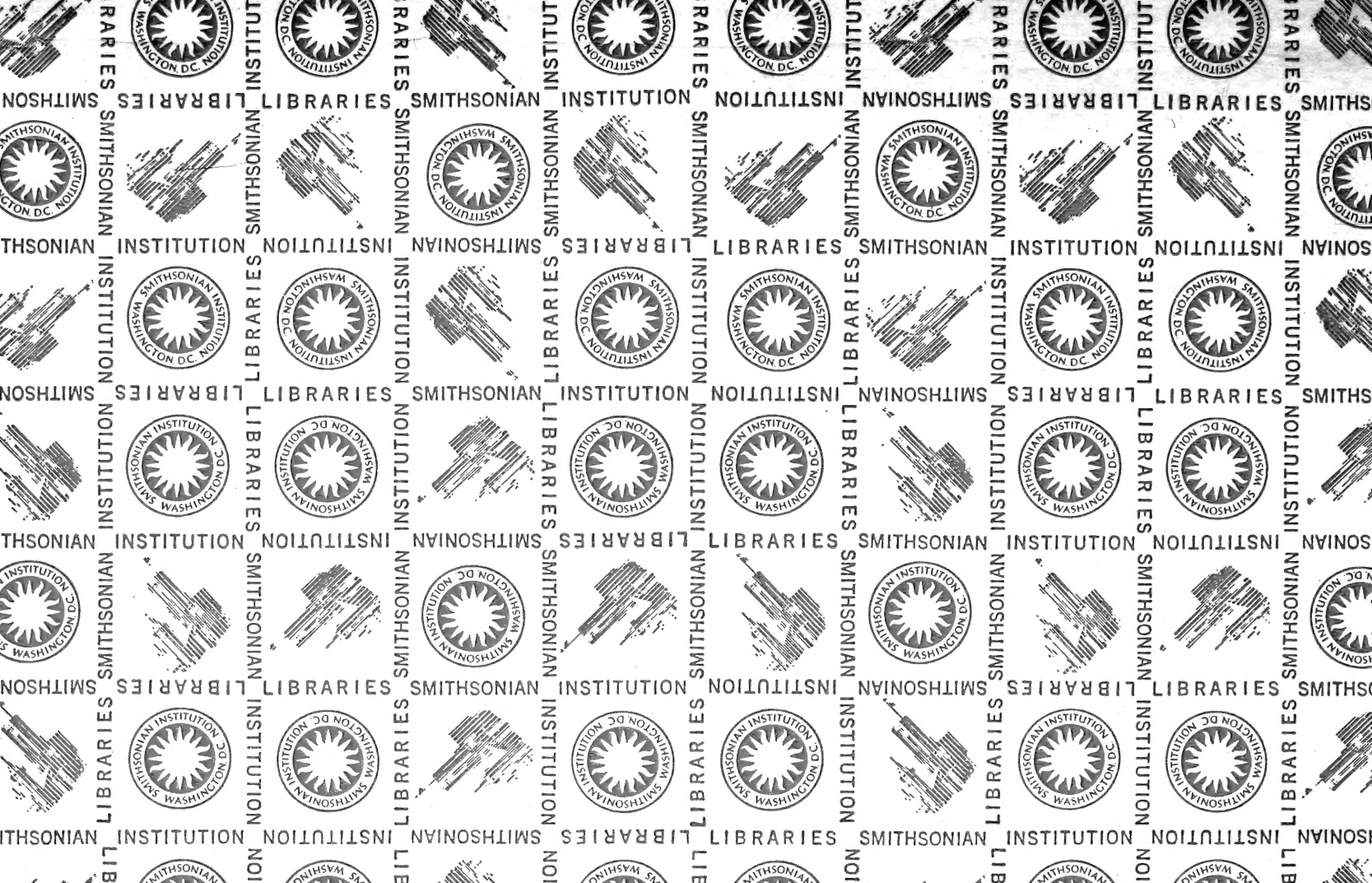
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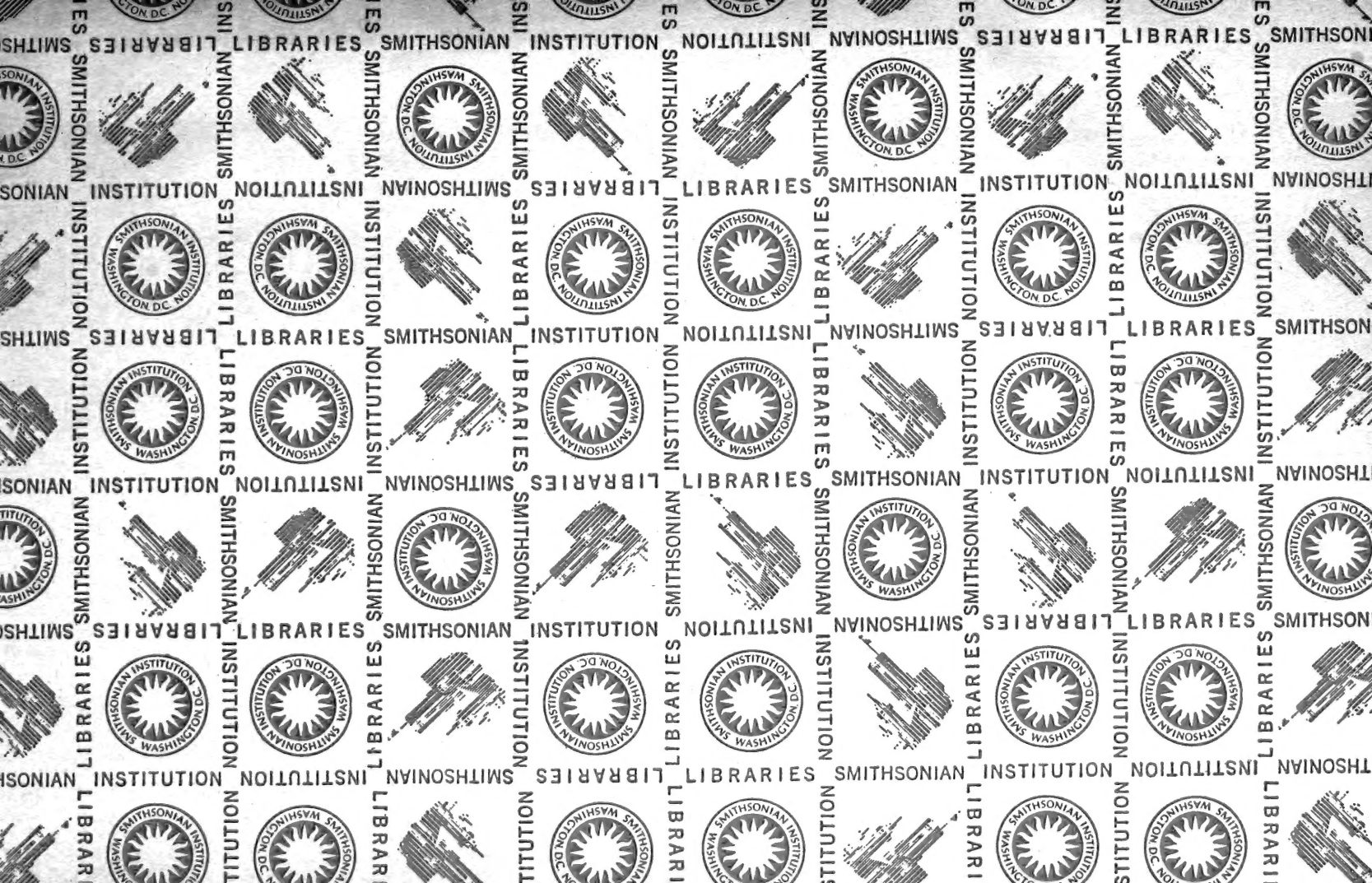
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VOL. 5 No. 21

SEPTEMBER 1898

GEOLOGY

OF THE

LAKE PLACID REGION

BY

JAMES FURMAN KEMP, E. M.

Prepared with the permission of Prof. James Hall, State Geologist, and Charles D. Wolcott, Director U. S. Geological survey

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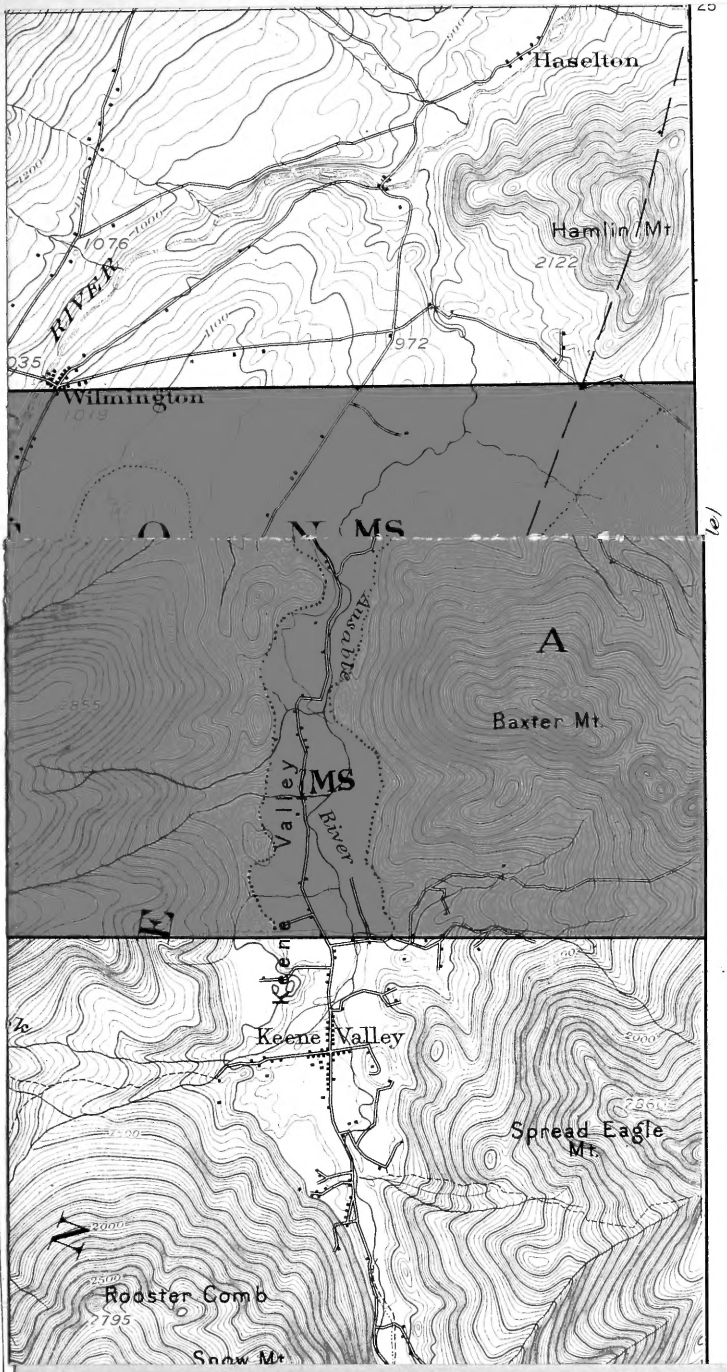
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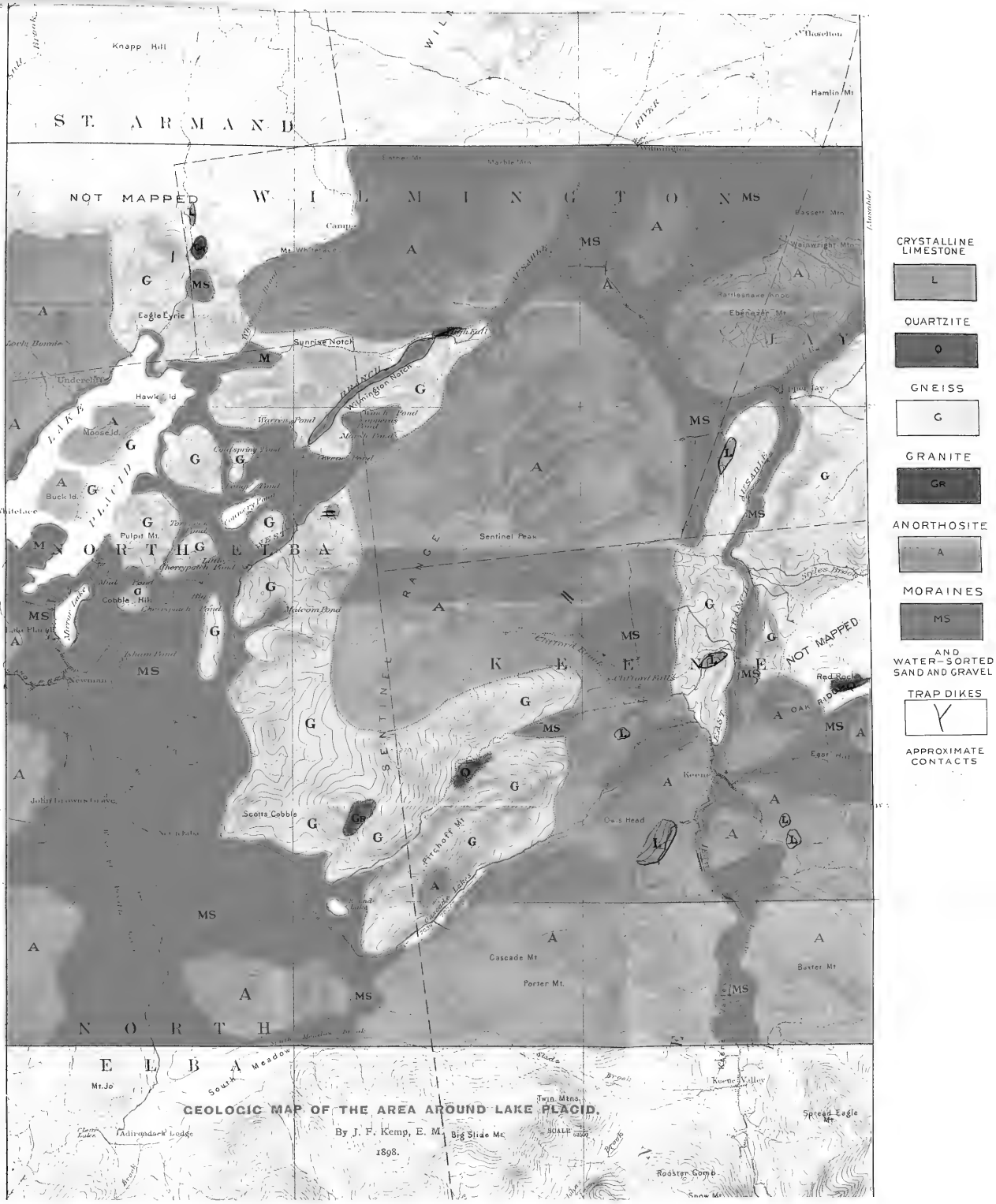

GEOLOGIC MAP OF THE AREA AROUND LAKE PLACID.

By J. F. Kemp, E. M.

1898.

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GEOLOGY OF THE LAKE PLACID REGION

INTRODUCTION

The following outline of the geology of the region about Lake Placid has been prepared from notes which were taken while the writer was in the field, first under the direction of Prof. James Hall, state geologist and later under that of Dr Charles D. Walcott, director of the United States geological survey. Acknowledgments are due both these gentlemen for permission to use the observations.

It has been the writer's aim to give an observer, and specially a teacher who might be sojourning in the region, a grasp of its larger geologic features, and to suggest the topics in regard to which our present knowledge needs amplification. The writer's attention has been thus far chiefly centered on the hard crystalline rocks as distinguished from the incoherent sands, gravels and moraines that rest on them. Much remains to be done in the study of these last named, for they give the clue to the recent geologic history of the valley and by a careful study of them and by distinguishing moraines, deltas, abandoned lake bottoms and their respective altitudes some interesting problems in geographic geology may be solved.

GEOGRAPHIC OUTLINE

If an observer stands on an elevated point near Lake Placid, with the relief map which will be found opposite p. 62 in hand he will note that the region about him lies to the northwest of the great central group of peaks, which constitutes the backbone of the Adirondacks. The Gothics, Marcy, McIntyre and their neighbors form the southeastern sky line and a broad, open valley lies between their foothills and the lake itself. Whiteface, one of the highest peaks bounds the lake on the north and with its spurs incloses the valley in this direction. Beyond Whiteface, the mountains decrease rapidly in size, and although for many miles the country is wild and rugged, the altitudes gradually decline to the plain that forms the south bank of the

St Lawrence river. The eastern side of the Lake Placid valley is chiefly formed by the fine massif of Sentinel mountain, whose northwestern spur is cleft from Mt Whiteface by the Wilmington Notch, and whose southern is similarly separated from Pitchoff mountain by the narrow pass through which runs the old but now abandoned road to the Keene valley. Pitchoff is in turn split off from Cascade and Porter mountains by the Cascadeville Notch, likewise a precipitous pass. It may be farther remarked that if one goes out to the south one must take the trail through Avalanch pass, another narrow cleft in the mountains, or else the still more famous Indian pass, which lies on the west side of Mt McIntyre, and which is in many respects the most impressive of all the Adirondack passes.

To the west the country is more open, and in driving to Saranac, a broader valley with much lower hills surrounding it is met. The present lack of topographic maps of this section has prevented its accurate study as yet, although its character can readily be seen by a drive or a walk.

The drainage of the Lake Placid valley passes out through the west branch of the Ausable river and enters Lake Champlain through the famous Ausable chasm, just north of Port Kent. The valley lies therefore in the St Lawrence drainage basin, but is near its southern limit. The headwaters of the Hudson are in Avalanch pass a few miles to the south.

In its smaller features the valley south of Lake Placid is to a great degree a plain of sand and gravel, now quite deeply dissected by the various streams which cut across it. Flat-topped hillocks, the stumps of the former general level remain and enable one to fill out its former conditions. Occasional moraines of sand and boulders, such as the one on which the Lake Placid hotels are built, diversify the surface, but the general aspect is that of a plain, whose relief is due to erosion.

The altitude of the lake above tide is 1864 feet. The West Branch at the High Fall is 1300 feet and at Wilmington village 1000, so that the rapid fall of the river explains the great amount of erosion that has been accomplished. The altitudes of the

several peaks in the immediate vicinity are as follows: Whiteface, 4872; Sentinel, 3858; Pitchoff, 3450; Cascade, 4092; Porter, 4070. Mt McIntyre, at 5112, can be reached and ascended in a day, and is second only to Mt Marcy at 5344. Of all the Adirondack peaks, these two alone, McIntyre and Marcy, exceed 5000 feet but several others approximate it closely.

Of the minor elevations near the lake, Eagle Eyrie is 2656, Pulpit mountain 2658, the two being practically the same, and Cobble hill is 2330.

ROCKS

The rocks proper, which include the 'hard' formations as contrasted with the incoherent sands and gravel, may be classified into 1) crystalline limestone, 2) quartzite, 3) granite, 4) gneiss, 5) anorthosites or the rocks consisting chiefly of labradorite feldspar, 6) trap dikes. If we add the incoherent sands and gravels, there are, 7) moraines of unsorted sands and boulders, large and small being commingled, and 8) water-sorted sands and gravels, forming abandoned lake bottoms and deltas now more or less modified by erosion both by wind and water.

Crystalline limestone. This rock is not in large amount but it is extremely significant in its geologic relations. Reference to the geologic map (cover p. 2) will indicate its presence in only one place so far as known in the town of North Elba and that is near the trail that leaves the Wilmington road at the house of Mr Watson. A small area outcrops in the bottom of a brook. In the valley of the east branch of the Ausable river, one outcrop occurs in the town of Jay. There are at least six or seven in Keene. The limestone is always a coarsely crystalline variety, and is formed of rather large individuals of calcite, through which smaller crystals of pyroxene, of the variety coccolite, are richly distributed in practically all cases. Graphite is often present and dark bunches of varying size consisting of black hornblende, quartz, pyrrhotite, feldspar and some rarer minerals are frequent. Traces of bedding have been destroyed and although the limestone shows as a rule a banded character, this is the result of pressure exerted during its metamorphism. The

invariable presence of the pyroxene and other silicates leads us to infer that the original limestone was an impure siliceous variety, and when metamorphism affected it, the silica, lime, magnesia and iron present, became combined in the included minerals. The limestones furnish the only localities attractive to the collector of minerals and some advice regarding them is given later under the head of mineralogy (p. 63). In fact loose bunches of pyroxene crystals, garnets and other characteristic aggregates and masses of black hornblende often remind us when doing field work that limestones must be near before the actual outcrop is discovered.

Quartzite. In two or more localities small outcrops have been met of a rock that seems to be excessively altered sandstone. One is on the old road from North Elba to Keene, and is in Keene township; the other is at the Red Rocks on the east side of the Keene valley. Additional ones of small size are met in a minor degree associated with the limestones of the Keene-Jay valley. The rock appears to the unaided eye to be an aggregate of little else than quartz grains through which flakes of graphite may occasionally be detected. When cut in thin section the rock from the old Keene road shows much emerald green pyroxene, and a little scapolite. All the minerals are strained and fractured and have clearly been subjected to great pressure. The outcrops in the two localities specially cited are in or near steep precipitous cliffs, that have been produced by faults.

The quartzites were doubtless originally sandstones that had sometimes carbonaceous matter, and sometimes lime, magnesia, iron and alumnia, sufficient in amount to yield the accessory minerals. Along the old Keene road the quartzite passes almost imperceptibly into a gneiss, that may itself be an altered sediment.

Granite. In four localities a rock has been met that corresponds to granite. One is on the steep sides of a spur of Mt Whiteface along the trail from the north end of Lake Placid to Franklin Falls. Another is at the High Falls in Wilmington Notch in the

bed of the stream. A third is in a hill a mile east of Scotts Cobble, and the fourth is in the bed of the East Branch at the cascade between Keene Center and the iron bridge a mile and a half south. In each case the rock is chiefly quartz and feldspar, in a coarsely crystalline aggregate. In thin section the quartz is found to be much strained from geologic movements, and the feldspar is the variety microperthite, being an orthoclase thickly set with little spindles of albite.

The three rocks above referred to, and the trap dikes to be later described are minor rock formations, nearly all the country being made up of the two that follow next.

Gneiss. Under this comprehensive name is included a considerable variety of rocks, all of which have however the distinguishing feature of 'gneiss' in strong development. That is, the light and dark minerals are arranged in rudely parallel bands so as to give a foliated or laminated aspect to the rock. The banding varies from coarse to fine, and is produced by innumerable flattened lenses of minerals, strung out with their long diameters parallel. The bands curve and eddy at times and strongly simulate the phenomena produced by the flow of a ropy or viscous fluid.

The commonest gneiss is a dark, and more or less rusty rock, with abundance of black minerals, set in a brown or green mass of feldspar. When a fresh exposure is produced either by pounding to the core of a large fragment or in blasting boulders and ledges for the improvement of highways, it is seen that the rock is a pronounced green. Red garnets are frequently quite prominent in it. In thin sections this variety is found to be chiefly composed of microperthitic feldspar and emerald green pyroxene. With these in places here and there are varying amounts of hornblende, hypersthene, quartz, garnet, magnetite apatite and zircon. When the quartz is abundant, varieties high in silica result; when it and the feldspar are in less amount, dark pyroxenic and hornblendic varieties occur in consequence.

In some gneisses large blue labradorites are quite prominent, but always in rudely lenticular form, giving the general impres-

sion of an eye, around which the dark minerals are ranged like eyelashes and eyebrows. For this reason it is customary to describe the labradorites as 'Augen' using the German word for eyes. They indicate relationships with the anorthosites, the next group of rocks.

The obscure geologic questions that arise in connection with the gneisses are those which deal with their original condition and the changes through which they have passed to reach their present condition. The gneisses are essentially 'metamorphic' rocks, and the term means that by recrystallization or by compression, crushing and consequent internal movements, or by both combined, they have been produced from sediments or from igneous rocks. It was formerly believed that the foliation represented the bedding of sediments, but it seems now more reasonable to regard it as the result of pressure and of a movement analogous to a viscous flow, that has strung out the minerals in lines. It is quite probable that some of the gneisses and specially those associated with the limestones and quartzites are altered sediments, and it is also probable that those with the labradorite augen are squeezed igneous rocks, but our investigations do not yet admit of their separation in mapping.

The gneisses are colored brown on the map, by reference to which it will be seen that they bound Lake Placid on the east and appear to some extent in the islands on the east side. Excellent exposures with pronounced foliation will be found in the cliffs of Pulpit mountain, on Eagle Eyrie and in Sunrise Notch. Along the West Branch they are the country rock. Pitchoff mountain and the southwest portions of Sentinel are composed of them and the ledges on the East Branch in Jay and northern Keene are the same. The boundaries between them and the anorthosites are not sharp and passage forms are met so that the areal distribution on the contacts is approximate. Repeated experience has, however, indicated both to the writer in Essex county, and to H. P. Cushing in Franklin county that dark gneisses with labradorite augen, often surround areas of anor-

thosite and that the transition from one to the other is a gradual one.

Anorthosites. The anorthosites may be considered to be the characteristic rocks of the Adirondacks. In their typical cases they consist of little else than blue labradorite and are then a most beautiful rock. A little pyroxene, mostly augite, appears as a rule, and hypersthene is frequent. The presence of the latter led Prof. Emmons in the early work of the New York state survey to call them hypersthene rock, or hypersthene, but this mineral is a subordinate one. Labradorite is the great component and the rocks might be fittingly described as 'labradorite rocks', following a custom prevalent in Norway, but in English the term is not a good rock name. They are sometimes described as norite meaning a rock composed of labradorite and hypersthene, but experience has indicated the scarcity of hypersthene, and here the word anorthosite is employed, which means a rock chiefly composed of plagioclase feldspar. The rocks resemble a coarse granite, the individual crystals being sometimes very large.

The typical anorthosites grade into varieties with more and more dark silicates and some of the areas colored red on the map have large and prominent amounts of them. These darker pyroxenic and hornblendic rocks are not anorthosites, strictly speaking but are gabbros and diorites; nevertheless the anorthosite is the prominent and characteristic variety and is here used with that understanding. The summit of Mt Whiteface and the southern portion of the mountain consists of a variety that contains large amounts of hornblende and pyroxene, together with milky white feldspar. It is so peculiar that we have been accustomed in the field to refer to it as the Whiteface type of rock. It is characteristic of this mountain ridge. Despite the peculiarities of the rock, it belongs beyond question in the anorthosite series, and is closely involved with typical anorthosites. The latter are found all around the base of the mountain toward Wilmington and on the trail from Wilmington village, to the summit, that passes over Marble mountain, typical anorthosites appear till the peak is nearly reached.

The anorthosites have not escaped the general results of squeezing and crushing that are so strongly shown by the gneisses. On the contrary the feldspar crystals in the area of the map are seldom if ever provided with sharp edges. A blue crystalline nucleus is surrounded by a crushed white pulp of comminuted feldspar, phenomena that will forcibly appeal to an observer as having been produced by pressure on a grand scale. They are also drawn out into gneissoid foliation in many instances, but this structure is not specially marked because of the lack of dark minerals, which accentuate it by contrast with the feldspar. Often a narrow rim of pink garnets will be noticed surrounding such dark silicates as appear in the anorthosite.

The anorthosites in typical development will be found on the west side of Lake Placid, and specially on the hilltop back of the Whiteface Inn. As the Whiteface type they constitute the peak of the same name. They bound the Wilmington valley so far as here mapped, and make up all the central part of the Sentinel range. To the south they become the prevailing rock and beyond the area of the map they form all the high peaks around Mt Marcy.

Trap dikes. The trap dikes constitute minor but striking members in the geology of the region. They are not numerous so far as known within the area of the map. They have been met almost always throughout the mountains, where some great fault line has formed a line of weakness, up through which they have found an outlet from the reservoirs of molten rock in the interior. They are all black basalt and in thin section are shown by the microscope to contain plagioclase feldspar and augite, as the most abundant minerals. Magnetite, apatite and sometimes brown hornblende are also present, and more or less glass.

A dike occurs about a mile north of Eagle Eyrie. A ramifying and very instructive network of them is well exposed at the High Fall in Wilmington Notch. Others were noted in the limestone area a mile or so south of the Notch proper. They occur northwest of Clifford Falls on the east slope of Sentinel. In the Cascade Notch, immediately opposite the hotel and beneath the 'cascade' there is another network of them, and still another in

the gorge of the East Branch a mile south of Keene Center. No doubt additional ones will be discovered by observation of the brook bottoms and the writer would be glad to be informed of any that may be met.

Moraines. The moraines of unsorted sand and boulders are the most striking evidence of the glacial period. They meet the eye of the visitor immediately on reaching Lake Placid, because the town is built upon a ridge formed of them. Huge boulders project from the sides of cuttings wherever the highways have been graded. This commingling of large rocks and fine sands will appeal even to the unscientific observer as only to be explained by the work of ice. This particular moraine is an important one because Lake Placid is the result of it. Like a great dam the glacial drift confines the water to the valley between the hills, while Mirror lake is in a depression in the dam itself.

Other moraines are not lacking in the region but as our observations are as yet too incomplete to accurately map them no distinction is made on the map. Some minor points of interest may however be mentioned. In the pass toward French's at the north end of Lake Placid, and beyond Eagle Eyrie, there is a huge boulder that is 25 x 20 x 15 feet, as determined by pacing. It stands by itself in the forest. Others of notable size are abundant on the hillsides south of Keene Center. The boulder at John Brown's grave is one of the sights familiar to the Lake Placid summer visitor.

The boulders in the moraines are chiefly the hard crystalline rocks already described. Occasionally one finds a fragment of Potsdam sandstone, that must have journeyed in from many miles to the north.

Water-sorted sands and gravels. These consist of pebbles and sand in a more or less clearly stratified condition. They tend specially to form level plains and fan shaped terraces. The plains appear to be abandoned lake bottoms, while the terraces are the deltas which entering streams built up in the former lakes. The deltas occur opposite the tributary valleys and

specially in the Keene valley, two or three distinct sets can be recognized. Similar phenomena on a small scale can be recognized in the present lakes.

The open valley south of Lake Placid gives much evidence of having once been a lake whose waters were held in, perhaps by an ice wall to the north. As earlier stated the stumps of the sandy plain, and the deltas need to be correlated as regards altitudes before we can be sure of the conditions surrounding the former lake. The valley in which the town of Wilmington lies is a striking case of a lake basin, and not less significant are the lake bottoms and deltas in the Keene valley and in the Elizabethtown valley. The latter is almost diagrammatic.

Geologic age. The hard crystalline rocks are of pre-Cambrian age, with the possible exception of the trap dikes. If the word archean is used in the original sense as proposed by the late Prof. Dana, for the formations that precede the fossiliferous strata, then the Lake Placid crystallines are archean. But if, as has been more recently proposed by the United States geological survey, the name archean is restricted to those ancient rocks that antedate all sediments, then the local formations must be called Algonkian, a name that applies to pre-Cambrian rocks that are sedimentary, or, if igneous, that are later than known sediments.

The name Laurentian has been widely employed for the ancient crystalline rocks in the text-books on geology, and as it was originally used in Canada for rocks geographically and geologically related to those under consideration here, it may be referred to. The Canadian geologists introduced the name Laurentian for the oldest crystalline rocks of the globe, and set off from them under the name Huronian, the metamorphosed sediments and igneous rocks that rest upon the Laurentian around Lakes Superior and Huron. With the exception of the trap dikes, the Lake Placid rocks are all Laurentian, but no Huronian rocks are known in the region.

Fairly extended observation throughout the Adirondacks has led to the conclusion that the limestones, quartzites and probably

some of the gneisses are the oldest rocks present. They represent the remnants of a once extended series that formed all the country. They have been invaded and broken up into small detached areas by the igneous anorthosites. The intrusions took place at quite profound depths in the earth, because the anorthosites have all the characteristics of rocks that have cooled and crystallized under pressure and slowly. The limestones were much affected by the neighboring masses of igneous rock and may owe to their influence the great numbers of included pyroxenes and other silicates.

Many facts otherwise inexplicable are accounted for by this conception, as for instance the presence opposite Cascadeville of a small mass of limestone, a sedimentary rock, in a great mountain of anorthosite, an igneous one. The limestone on the northwestern extremity of Pitchoff is a still more striking case, while fragments of quartzite have been found in the anorthosites of the high peaks, as for instance on the summit of the Gothics. The exact relations of the granites to the anorthosites in time, are uncertain, but the granites are probably later.

After the intrusion of the anorthosites great metamorphism ensued, that crushed the component minerals and produced much gneissoid foliation. The rocks were apparently under such compression and strain, that they flowed like a viscous fluid, and the minerals became strung out in linear arrangement. It all occurred however before the deposition of the Potsdam sandstone, because we find the latter to the north and east resting unchanged on the older metamorphic rocks.

The trap dikes were certainly intruded after the metamorphism, for they show no evidence of having been squeezed or sheared. In the region to the north, H. P. Cushing has found dikes that cut the old crystallines, but stop at the Potsdam, and do not penetrate it. He therefore has concluded that they were intruded before the Potsdam was deposited. The writer has found others in the Lake Champlain region that pierce strata even as late as the Utica slate. Clearly therefore two series are present in the mountains, but to which of the two

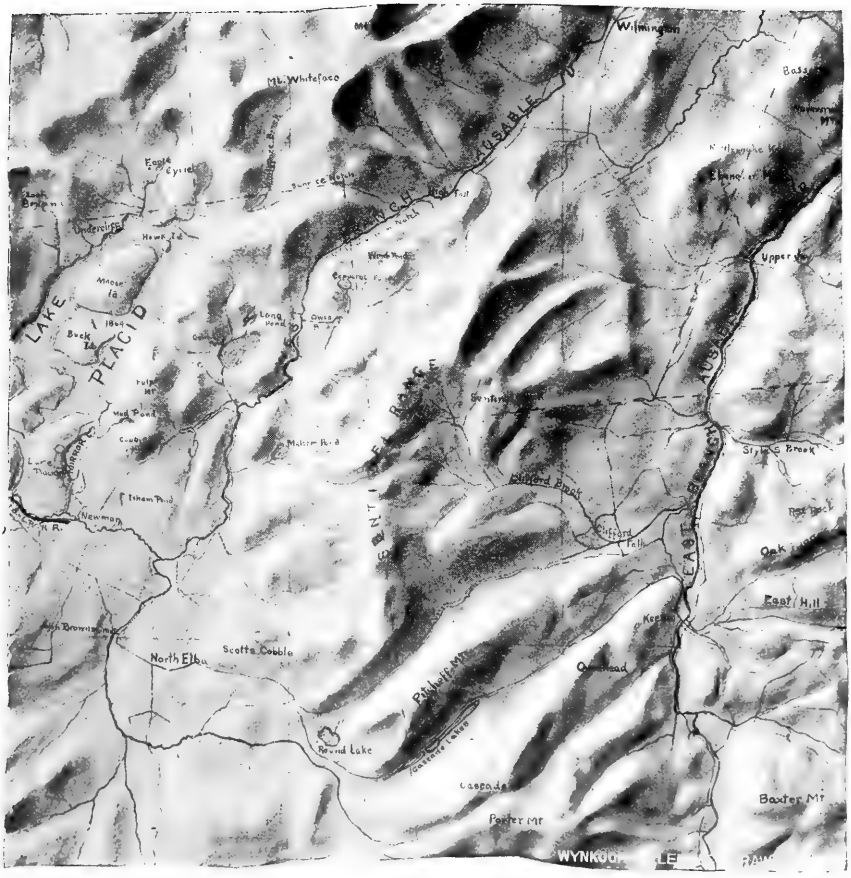
the dikes around Lake Placid belong, we can not say from the local evidence.

As to what took place in this region in the long interval of time represented by the paleozoic and mesozoic eras and the tertiary period, we can but imagine and most imperfectly. Whether the mountains were leveled off, submerged and buried under strata that have since been removed, or whether they were a land area, that suffered great denudation and furnished material for later sediments, we have slight means of knowing. For the later paleozoic and for the mesozoic and tertiary the latter supposition is the more reasonable. Careful study of the physiography may throw some light on the tertiary or even on the later mesozoic times, if remnants of old drainage systems can be made out. Presumably their outlines were not so very different from the present ones.

At some time in this interval the great faults were developed that have served to block out the individual mountains and valleys and that are the primary causes of the relief and of the present drainage. The crushing of the rocks from the faulting gave the rivers their easiest lines of erosion. This inference is corroborated by the cracked and jointed condition of the rocks in the channels, where exposed, and by the steep, precipitous cliffs in the passes, which are due to the scaling off of platy masses along the old lines of fracture. These movements may have occurred in quite recent geologic time, but in no case have we found faulted glacial deposits.

With the opening of the quaternary period came the invasion of the continental glacier and the production of the moraines, boulders and beautiful glacial amphitheaters or cirques on the slopes of Whiteface and Sentinel. The boulders of Potsdam sandstone indicate a movement from the northeast, and the few glacial striae that have been met corroborate the inference. They are not common in the area of the map and should be looked for with care and their directions should be taken with a compass.

The configuration of the mountain slopes is strikingly characteristic of ice action, and if the reader will observe on the relief


Wilmington
Mt. Whiteface
Eagle Eyrie
Underclift
Hawk Id
Moose Id
Buck Id
Long Pond
LAKE PLACID
Mid Pond
Cobble
Saranac R.
Newman
Ausable Pond
Matern Pond
Scotts Cobble
North Elba
Round Lake
Cascade
Porter Mt
Pitchoff Mt
Gastenel Lakes
Clifford Brook
Clifford Falls
Keene
Queensbury
East Hill
Oak
Spring Brook
Upper Ausable Lake
Baxter Mt
WYNKOOP
EAST BRANCH AUSABLE
BRANCH
NORTH
FORK

map, opposite p. 62, the eastern front of Whiteface for example, he will be impressed with the amphitheaters, setting back against precipitous walls, that are everywhere present. The same is true of Sentinel mountain about the headwaters of Clifford brook. Ice appears to have stood in these recesses and to have worked the sides back to the comparatively steep walls which confront us to-day. The open space or 'bergschrund', that usually intervenes as a huge crack between the ice of a glacier and its inclosing wall, is a place of specially active disintegration of rock. The thaw by day is succeeded by freezing during the night and the walls scale off to a fairly vertical condition with exceptional rapidity. An amphitheater with steep walls results, which is a favorite form for the Adirondacks, being well shown on Giant, on the Gothics and not a few other peaks.

The melting of the ice sheet and its retreat, the temporary blocking of lines of drainage and perhaps general submergence of the region led to the production of lake basins, with their attendant deltas and sand plains, now a most suggestive feature of the landscape, but observations, as already stated, have not yet been made in sufficient detail to work out their number, succession and relative altitudes.

MINERALOGY

The larger formations present little that is attractive to the collector of minerals. The labradorite crystals of the anorthosites occasionally reach such dimensions and perfection of development as to exhibit the characteristic twinning striations on cleavage faces. Rarely they show the characteristic play of colors of the labradorite from eastern Canada.

The included masses of limestone are much more prolific. At Cascadeville beautiful light green coccolite is distributed through white calcite. Small dark brown or black garnets are associated, but neither the garnet nor the pyroxene possesses good crystal boundaries, as the individuals have the rounded or corroded aspect, so often seen on minerals contained in limestone.

In earlier notices of this locality zircon and vesuvianite are mentioned but the writer has been unable to find them. Magnetite with included pyrites is available near the Cascade.

At the Weston mine in Keene, magnetite, yellow and brown garnets and pyroxene are quite abundant but the forms are rude in outline. In limestone areas outside the limits of the map, good crystals of pyroxene, titanite, hornblende and quartz can sometimes be freed by acid from the inclosing calcite. They are found in the bunches of silicates that are included in the limestone even up to large size. Calcite and pyrite have also been seen. They may all be found in the future in the outlying areas of limestone shown on the map, and to these a collector may most profitably direct his search.

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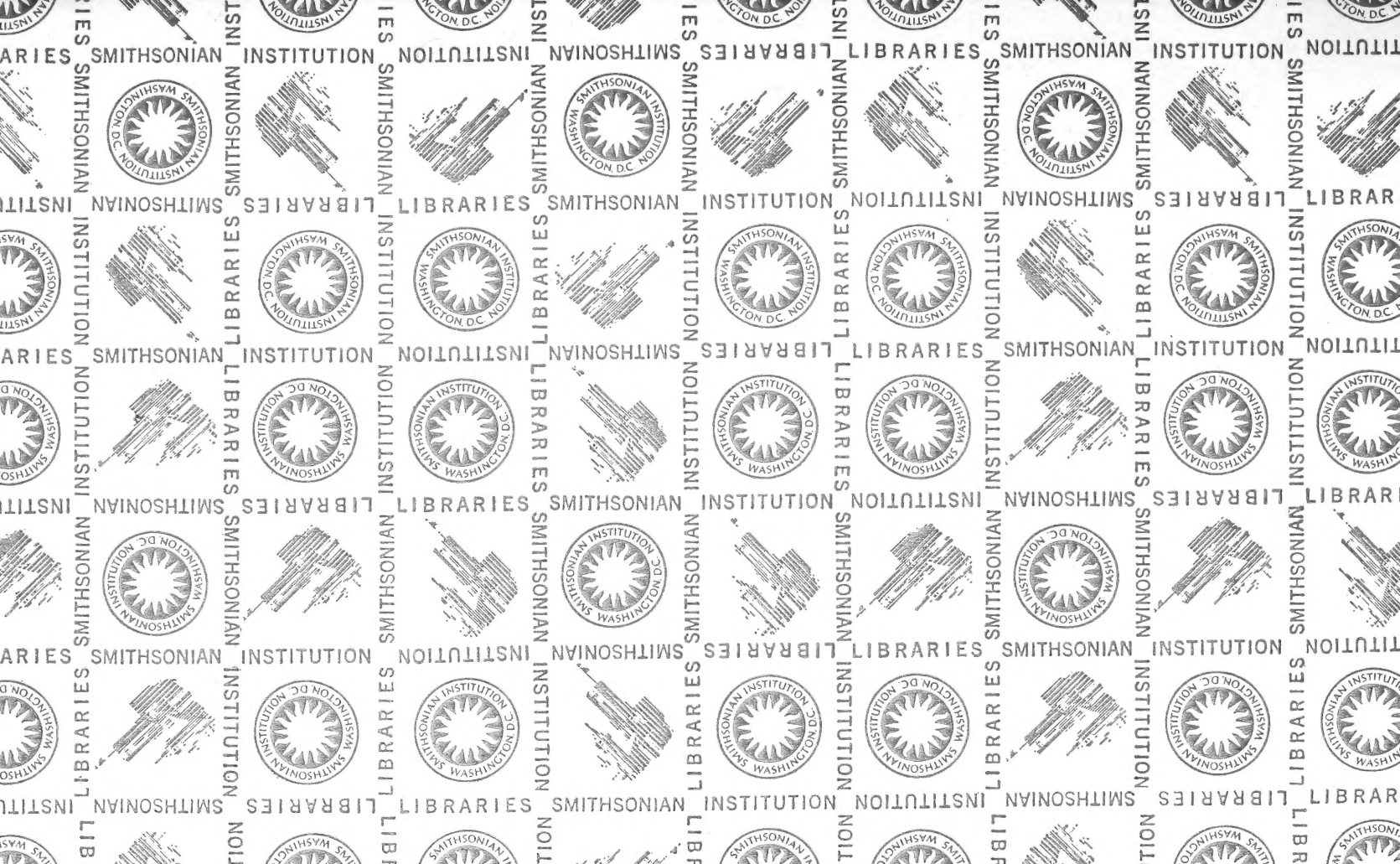
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