E

Eleusine indica, LaMarck.
Elymuscanadensis, v. glaucifolius, Torrey.
Hystrix, Linn. Hedgehog-grass
villosus, Muhl. Lime-grass
virginicus, Linn. Wild rye
Epigaea repens, Linn. Trailing arbutus
Epilobium coloratum, Muhl.
lineare, Muhl.
molle, Torrey.
Epiphegus virginianus, Barton. Beech-drops
Erigeron bellidifolus, Ww.
canadense, Linn. Flea-bane
heterophyllus, Muhl.
philadelphicus, Linn.
strigosus, Muhl.
Eriocaulon pellucidum, Mx.
Eriophorum angustifolium? Bw.
polystachyon, Linn. Cotton grass
Eryngium aquaticum, Linn. Button snake root
Erythronium americanum, Smith. Dog tooth violet
Euchroma coccinea, Nutt. Painted cup
Euonymus americanus, Linn.
obovatus, Nutt.
Eupatorium ageratoides, Linn.
amoenum, Pursh.
perfoliatum, Linn. Boneset, Thorough wort
sessilifolium, Linn.
Euphorbia corolata, Linn.
maculata, Linn.
polygonifolia, Linn.
Equisetum arvense, Linn. Horse tail
hyemale Linn. Scouring rush
limosum, Torrey.

F

Fagus sylvatica, Linn. Beech
Festuca duriuscula? Linn.
nutans, Ww.
tenella, Ww.
Fragaria virginiana, Linn. Strawberry
Frasera caroliniensis, Walter. Columbo
Fraxinus acuminata, La Marck. White ash
pubescens, Walter. Red ash
sambucifolia, Ww. Black ash
Fuirena squarrossa, Mx.

G

Galeopsis Tetrahit, Linn. Flowering nettle
Galium asprellum? Mx.
boreale, Pursh.
circaezans, Mx.
lanceolatum, Torrey
obtusum? Bw.
pilosum, Aiton.
tinctorium, Linn. Wild madder
trifidum, Linn.
Gaultheria hispidula, Muhl.
procumbens, Linn. Wintergreen
Gaura biennis, Linn. Virginian loosestrife
Gentiana crinita, Froelich. Fringed gentian
quinqueflora, Ww.
saponaria, Linn. Soap gentian
Geranium maculatum, Linn. Crane's bill
robertianum, Linn.
Gerardia auriculata, Mx.
flava, Linn. False foxglove
glauca, Eddy.
pedicularia, Linn.
purpurea, Linn.

Geum rivale, Linn. Purple avens
strictum, Aiton. Upwright avens
virginianum, Linn. Avens
Gleditschia triacanthos, Linn. Honey locust
Glyceria fluitans, Brown. Water fescue grass
Gnaphalium plantagineum, Linn.
polycephalum, Mx. Life everlasting
uliginosum, Linn. Cud weed
Goodyera pubescens, Brown. Rattle snake plantain
Gyromia virginica, Nutt. Indian cucumber

H

Habenaria bracteata, Brown. Vegetable satyr
ciliaris, Brown. Orchis
dilatata, Pursh. Giant orchis
fimbriata, Brown.
grandiflora, Torrey.
herbiola, Brown.
huronensis, Sprengel.
orbiculata. Pursh.
psycodes, Sprengel.
tridentata, Hooker.
Hamamelis virginica, Linn. Witch hazel
Hedeoma pulegioides, Persoon. Pennyroyal
Helenium autumnale, Linn.
Helianthemum canadense, Mx. Rock rose
Helianthus altissimus, Linn.
divaricatus? Linn.
frondosus, Ww.
giganteus, Linn.
gracilis
strumosus, Linn.
trachelifolius, Ww.
Heliopsis laevis, Persoon.
Hepatica acutiloba, D. C.
americana, D. C. Liverwort

Heracleum lanatum, Mx. Masterwort. Cow parsnip
Heuchera americana, Linn. Alum root
Hibiscus trionum, Linn.
Hieracium Gronovii, Linn.
kalmii, Linn.
marianum, Ww.
Paniculatum, Linn.
scouleri, Hedwig.
venosum, Linn. Blood wort
Hippophae canadensis, Ww. Sea buckthorn
Hippuris vulgaris, Linn.
Houstonia cillolata, Torrey.
Hydrastis canadensis, Linn. Golden seal. Yellow root
Hydrocotyle umbellata, Linn.
Hydropeltis purpurea, Mx. Water shield
Hydrophyllum canadense, Linn. Rough burr flower
virginicum, Linn. Burr flower
Hypericum ascyroides, Ww.
canadense, Linn.
parviflorum, Ww.
prolificum, Linn.
punctatum, La Marck.
virginicum, Linn.
Hypoxis, erecta, Linn. Star grass
Hyssopus nepetoides, Ww. Giant hyssop
scorphularifolius, Ww.

I

Ictodes foetidus. Bw. Skunk cabbage
Impatiens fulva, Nutt. Speckled jewels
palida, Nutt. Jewel weed
Inula Helenium, Linn. Elecampane
Iris versicolor, Linn. Wild flag
Isnardia palustris, Linn. Water purslane

J

Juncus acuminatus, Mx.
bufonius, Linn.
effusus, Linn. Bulrush
nodosus, Linn.
polycephalus, Mx.
cetaceus, Rostk.
tenuis, Ww.
Juniperus communis, Linn. Juniper
virginianus, Linn. Red cedar

K

Kalmia glauca, Aiton. Swamp laurel
Krigia amplexicaulis, Mx.
Koeleria nitida, Nutt.
pennsylvanica, D. C.
truncata, Torrey.
Kuhnia critonia, Ww.

L

Lactuca elongata, Muhl. Wild lettuce
sanguinea, Bw. Wood lettuce
Lathyrus ochroleucus, Hooker.
myrtifolius, Muhl.
palustris, Linn. Marsh pea
venosus, Muhl.
Laurus Benzoin, Linn. Spice bush. Fever bush
sassafrass, Linn. Sassafrass tree
Lechea major, Mx. Pinn weed
Leersia oryzoides, Swartz. Cut grass
virginica, Ww. White grass. Rice grass
Lemna minor, Linn. Green duck meat
polyrrhiza, Linn. Water flax seed
triscula, Linn. Duckmeat
Leontice thalictroides, Linn. Poppoose-root. False cohosh
Leontodon Taraxacum, Linn. Dandelion

Leonurus cardiaca, Linn. Motherwort
Lepidium virginicum, Linn. Wild peppergrass
Leptandra virginica, Linn. Culver's physic
Lespedeza angustifolia, Elliott.
capitata, Mx.
polystachia, Mx.
prostrata? Pursh.
reticulata, Persoon.
violacea, Persoon.
Liatris cylindrica, Mx.
scariosa, Ww.
spicata, Ww. Gay feather
squarrosa? Ww.
Lilium canadense, Linn. Nodding lily
philadelphicum, Linn. Red lily
Lindernia attenuata, Muhl. False hedge hyssop
dilatata, Muhl. Pimpernel
Linnaea borealis, Gronovius. Twin flower
Linum usitatissimum, Linn. Flax
virginianum, Linn. Wild flax
Liriodendron tulipifera, Linn. Whitewood. tulip tree
Lithospermum officinale, Linn. Gromwell
Lobelia cardinalis, Linn. Cardinal flower
Claytoniana, Mx.
Kalmii, Linn.
siphilitica, Linn.
Lolium temulentum, Linn.
Lonicera parviflora, LaMarck.
Ludwigia alternifolia, Ww. Seed box
Lupinus perennis, Linn. Wild lupine
Luzula campestris, D. C.
pilosa, Ww.
Lycopus europeus, Linn. Water horehound
virginicus, Linn. Bugle-weed

Lysimachia capitata, Pursh.
ciliata, Linn. Money wort
hybrida, Mx.
quadrifolia, Linn.
revoluta, Nutt.
stricta, Aiton. Loosestrife
Lythrum Salicaria, Pursh. Milk willow herb
Lycopodium complanatum, Linn. Ground pine
lucidulum, Mx. Moon-fruit pine

M

Malaxis lillifolia, Ww. Twayblade
Malva rotundifolia, Linn. Low Mallows
Marrubim vulgare, Linn. Horehound
Melanthium glaucum, Nutt.
Menispermum Canadense, Linn. Moonseed
Mentha borealis, Mx. Horsemint
piperita, Smith. Peppermint
Menyanthes trifoliata, Linn. Buckbean
Microstylis ophioglossoides, Nutt.
Milium effusum, Linn. Millett
pungens, Torrey. Dwarf milletgrass
Mimulus alatus, Linn.
ringens, Linn. Monkey flower
Mitchella repens, Linn. Checkerberry. Partridgeberry
Mitella cordifolia, LaMarck.
diphylla, Linn. Currant leaf
Momordica echinata, Muhl.
Monarda allophylla, Mx.
punctata, Linn.
Mollugo verticillata, Linn. Carpet weed
Monotropa uniflora, Linn. Indian pipe-bird's nest
Muhlenbergia diffusa, Schreber. Dropseed grass
Myriophyllum verticillatum, Linn. Water milfoil

N

Nasturtium amphibium, Brown. Water radish
natans, D. C.
palustre, D. C.
Nemopanthes canadensis, D. C. Wild holly. Mountain holly
Nemophila paniculata, Sprengel.
Nepeta cataria, Linn. Catnip
Nicandra physaloides, Persoon
Nuphar advena, Aiton.
Kalmiana, Aiton.
Nymphaea odorata, Aiton. White pond lily
Nyssa multiflora, Walter. Pepperidge.

O

Œnothera biennis, Linn. Scabish
fruticosa, Linn. Sundrops
muricata, Linn.
pumila, Linn.
Onoclea sensibilis, Linn. Sensitive fern
Onosmodium hispidum, Mx. False gromwell
Orobanche americana, Linn.
uniflora, Linn. Squaw root. Cancer root
Oryzopsis asperifolia, Mx. Mountain rice
Osmorhiza brevistylis, D. C.
longistylis, D. C. Sweet cicily
Osmunda cinnamomea, Linn. Flowering fern
interrupta, Mx.
regalis, Mx.
Ostrya virginica, Ww. Hop hornbeam. Iron wood
Oxalis stricta, Linn. Yellowwood sorrel. Sheep sorrel
Oxycoccus macrocarpus, Pursh. Cranberry

P

Panax quinquefolia, Linn. Ginseng
trifolia, Linn. Dwarf groundnut

Panicum capillare, Linn.
crus-galli, Linn. Barn grass
dichotomum? Linn.
nervosum, Muhl.
nitidum, LaMarck, and varieties. Panic grass
pubescens, LaMarck.
virgatum, Linn.
Parnassia americana, Muhl. Flowering plantain
Pastinaca sativa, Linn. Parsnip
Pedicularis canadensis, Linn. Lousewort
pallida, Pursh.
Penthorum seaboides, Linn. Virginian orpine
Pentstemon pubescens, Aiton. Beard tongue
Phalaris americana, Elliott. Wild canary grass
Phaseolus diversifolius, Persoon.
Phleum pratense, Linn. Timothy grass
Phlox aristata, Mx.
Phragmites communis, Trinius. Common reed
Phryma leptostachya, Linn. Lopseed
Physalis obscura, Mx. Ground cherry
Phytolacca decandra, Linn. Pokeberry
Pinus pendula, Aiton. Tamarack. Hackmatack
resinosa, Aiton. Yellow pine. Red pine
strobus, Linn. White pine
Piptatherum nigrum, Torrey. Clustered millet grass
Pisum maritimum, Linn.
Plantago cordata, LaMarck.
lanceolata, Linn. Snake plantain
major, Linn. Plantain
Platanus occidentalis, Linn. Buttonwood. Sycamore
Poa annua, Linn.
aquatica v. americana, Torrey.
capillaris, Linn.
compressa, Linn. Bluegrass
eragrostis, Linn.
hirsuta, Mx.

memoralis, Linn.
nervata, Ww.
pratensis, Linn. English grass. Meadow grass
reptans, Mx.
serotina, Ehrhart.
trivialis, Linn. Pasture grass
Podophyllum peltatum, Linn. Mandrake. May apple
Pogonia ophioglossoides, Brown. Snake-mouth arethusa
Polanisia graveolens, Rafinesque
Polygala cruciata, Nutt.
paucifolia, Ww. Flowering wintergreen
paucifolia v. alba, Eights.
purpurea, Nutt.
Senega, Linn. Seneca snake-root
verticillata, Linn. Dwarf snake root
Polygonum amphibium, Linn. Mud knot-weed
arifolium, Linn.
aviculare, Linn. Knot-grass
Convolvulus, Linn. Blind knot-weed
Fagopyrum, Linn. Buckwheat
lapathifolium, Linn.
mite, Persoon. Tasteless knot-weed
pennsylvanicum, Linn.
persicaria, Linn. Heart's ease, Lady's thumb
punctatum, Elliott. Water pepper
sagittatum, Linn.
scandens, Linn.
tenue, Mx.
virginianum, Linn.
Polymnia canadensis, Linn. White leaf-cup
Uvedalia, Linn. Yellow leaf-cup
Polypogon racemosus, Nutt.
Pontederia cordata, Linn. Pickerel-weed
Populus canadensis, Mx.
candicans, Aiton. Balsam poplar
grandidenta, Mx. Tree poplar
tremuloides, Mx. White poplar. American aspen

Porcelia triloba, Persoon. Pawpaw. Custard apple
Portulacca oleracea, Linn. Purslane
Potamogeton heterophyllum, Schreber.
natans, Linn. Pond-weed
lucens, Linn.
pectinatum, Linn.
perfoliatum, Linn.
zosterifolium. Trinius.
Potentilla Anserina, Linn. Tansey cinquefoil, Silver-leaf
arguta, Pursh.
canadensis, Linn. Five-finger
Comarum, D. C. Marsh five-finger
fruticosa, Linn. Shrubby cinquefoil
norvegica, Linn. Cinequefoil
Prenanthes racemosa, Mx.
Serpentaria, Pursh.
Prinos verticillatus, Linn. Winterberry. False alder
Prunella vulgaris, Linn. Heal all. Self heal
Prunus americana, Marshall. Meadow plum
depressa, Pursh. Sand cherry
obovata, Beck.
pennsylvanica, Aiton.
Ptelea trifoliata, Linn.
Pteris aquilina, Linn. Common brake
Pycnanthemum virginicum, Persoon. Virginian thyme
Pyrola elliptica, Nutt. White wintergreen
rotundifolia, Linn. Shin-leaf
secunda, Linn. One-sided shin-leaf
umbellata, Linn. Prince's pine
Pyrus coronaria, Linn. Crab apple
melanocarpa, Ww.

Q

Quercus alba, Linn. White oak
bicolor, Ww. Swamp white oak
imbricaria, Mx. Shingle oak. Laurel oak

macrocarpa, Linn. Over-cup oak. Burr oak
rubra, Linn. Red oak
Queria canadensis, Linn. Forked chickweed

R

Ranunculus abortivus, Linn.
acris, Linn. Crowfoot. Butter-cup
aquatilis, Linn. Water crowfoot
fascicularis, Muhl
lacustris, Beck and Tracy. Lake crowfoot
pennsylvanicus, Linn.
recurvatus, Poiret
repens, Linn.
Ranunculus sceleratus, Linn. Celery crowfoot
Rensslaeria virginica, Beck. Water arum
Rhamnus franguloideus, Mx. Dwarf alder
Rhus copallina, Linn. Mountain sumach
glabra, Linn. Sleek sumach
radicans, Linn. Poison ivy
toxicodendron, Linn. Poison ash
typhina, Linn. Sumach
venenata, D. C. Poison elder. Poison sumach
Rhynchospora alba, Vahl.
glomerata, Vahl. False bog rush
Ribes floridum, L'Heritier. Wild black currant
gracile, Mx.
triflorum, Ww. Wild gooseberry
Rochelia lappula, R. and S.
virginiana, R. and S.
Rosa carolina, Linn. Swamp rose
parviflora, Ehrhart. Wild rose
Rubus frondosus, Bw. Leafy raspberry
occidentalis, Linn. Thimbleberry. Black raspberry
sexatilis, Mx.
trivialis, Mx. Creeping Blackberry. Dewberry
villosus, Aiton. High blackberry

Rudbeckia hirta, Linn.
laciniata, Linn. Cone-flower
pinnata, Mx.
purpurea, Linn.
Ruellia strepens, Linn. Ruel
Rumex acetosellus, Linn. Field sorrel
acutus, Linn.
brittanicus, Linn.
crispus, Linn. Yellow dock

S

Sabbatia angularis, Pursh. American centaury
Sagittaria sagittifolia, Linn. Arrow-head
Salix Muhlenbergia, Ww. Speckled willow
recurvata, Pursh. Shrub willow
rosmarinfolia, Linn. Rosemary willow
Sanguinaria canadensis, Linn. Blood-root
Sambucus canadensis, Linn. Black-berried elder
pubescens, Persoon. Red-berried elder
Sanguisorba canadensis, Linn. Burnet saxifrage
Sanicula marylandica, Linn. Sanicle
Saponaria officinalis, Linn. Soap-wort. Bouncing Bet
vaccaria, Linn. Field soap-wort
Sarracenia purpurea, Linn. Side-saddle
Saururus cernuus, Linn. Lizard's tail
Saxifraga pennsylvanica, Linn. Water saxifrage
Scheuchzeria palustris, Linn. Less flowering rush
Schoenus mariscoides, Muhl. Water bog rush
Schollera graminea, Barton. Yellow-eyed water-grass
Scirpus acicularis, Linn.
acutus, Muhl.
americanus, Persoon.
autumnalis, Linn.
brunneus, Muhl.
capillaris, Linn.
capitatus, Linn.

Erisphoruo, Mx.
equisetoides, Elliott.
lacustris, Linn.
lineatus, Mx.
macrostachyos, Muhl.
palustris, Linn. Marsh club rush
spadiceus, Linn.
sub-squarrosus, Muhl.
sub-terminalis, Torrey.
tenuis, Ww. Club rush
Scleria triglomerata, Mx. Whip-grass
Scrophularia lanceolata, Pursh.
marylandica, Linn. Fig-wort
Scutellaria ambigua, Nutt.
cordifolia, Muhl.
galericulata, Linn. Scull-cap
lateriflora, Linn. Mad-dog scull-cap
Senecio Balsamitae, Muhl. Balsam groundsel
hieracifolius, Linn. Fire-weed
Senecio vulgaris, Linn. Groundsel
Setaria glauca, P. de B. Fox tail. Panic grass
Sida Abutilon, Linn. Indian mallows
Silene antirrhina, Linn. Sleepy catch fly
stellata, Aiton.
Silphium gummiferum, Elliott. Rosin plant
perfoliatum, Linn. Ragged cup
terebinthinaceum, Linn. Prairie dock
Sinapis nigra, Linn. Black mustard
Sisymbrium officinale, Scopoli. Hedge mustard
Sisyrinchium anceps, Cavanilles. Blue eyed grass
Sium latifolium, Linn. Water parsnip
Smilacina bifolia, Des Fontaines. Dwarf Solomon's seal
racemosa, Des Fontaines. Spiked Solomon's seal
stellata, Des Fontaines

Smilax herbacea, Linn. Bohea tea
peduncularis, Muhl. Jacob's ladder
rotundifolia, Linn. Horse brier. Green brier
Solanum nigrum, Linn. Deadly nightshade
Solidago axillaris, Pursh.
canadensis, Linn. Canadian golden rod
juncea, Aiton.
flexicaulis, Linn.
lanceolata, Aiton.
memoralis, Aiton.
rigida, Linn.
serotina, Aiton. Smooth golden rod
Sonchus oleraceus v. aspera, Linn. Sow thistle
Sparganium americanum, Nutt. Lake burr reed
ramosum, Smith. Burr reed
Spartina cynosuroides, Ww. Spiked salt grass
Spergula arvensis, Linn.
Spiraea lobata, Jacquin.
opulifolia, Linn. Nine bark, hard hack. Snow ball
salicifolia, Linn. Willow hard hack
tomentosa, Linn. Steeple bush
Spiranthes cernua, Richard. Nodding ladies' tresses
gracilis, Beck.
tortilis, Richard.
Stachys aspera, Mx. Hedge nettle
hyssopifolia, Mx.
Staphylea trifolia, Linn.
Stellari longifolia, Muhl.
media, Smith. Chick weed
Stipa avenacea, Linn.
juncea, Pursh.
Streptopus roseus, Mx. Rose bell-wort

T

Teprosia virginica, Persoon. Goat's rue
Teucrium canadense, Linn. Wood sage

Thaclictrum cornuti, Hooker.
dioicum, Linn. Meadow rue
Thaspium barbinode, Nutt.
Thesium umbellatum, Muhl. False toad flax
Thuya occidentalis, Linn. White cedar. Arbor vitae
Tiarella cordifolia, Linn. Mitre wort
Tilia glabra, Ventenant. Basswood. Limetree
Tofieldia glutinosa, Mx.
Tradescantia virginica, Linn. Spider wort
Trichodium laxiflorum, Mx.
scabrum, Muhl.
Tricuspis sesleroides, Torrey. Red top
Trientals americana, Pursh. Chick wintergreen
Trifolium pratense, Linn. Red clover
repens, Linn. White clover
Triglochin maritima, Linn. Arrow grass
palustre, Linn. Marsh arrow grass
Trillium erectum, Linn. False wake robin
erythrocarpum, Mx. Smiling wake robin
grandiflorum, Salisbury.
Triosteum perfoliatum, Linn. Fever root. Wild coffee
Triphora pendula, Nutt. Three bird orchis
Trisetum purpurascens, Torrey.
Typha latifolia, Linn. Cat tail. Reed mace

U

Ulmus fulva, Mx. Slippery elm. Red elm
Urtica canadensis, Linn. Canada nettle. Albany hemp
capitata, Linn.
dioica, Linn. Common nettle
pumila, Linn. Stingless nettle
Utricularia fornicata? LeConte.
gibba, Gronovius.
macrorhiza, LeConte. Bladder wort
purpurea, Walter.
Uvularia grandiflora, Smith.
sessilifolia, Linn.

V

Vaccinium pennsylvanicum, LaMarck. Whortleberry
resinosum, Aiton. Black whortleberry
Verbascum Blattaria, Linn. Moth mullein
thapsus, Linn. Mullein
Verbena caroliniana? Pigmy vervain
hastata, Linn. Vervain
urticifolia, Linn. Nettle leaf vervain
Vernonia nove boracensis, Ww. Flat top
Veronica Anagallis, Linn. Brook pimpernel
arvensis, Linn. Wall speedwell
beccabunga, Linn.
scutellata, Linn. Scull-cap speedwell
Viburnum acerifolium, Linn. Arrow wood
oxycoccus, Pursh. High cranberry
pubescens, Pursh.
Vicia americana, Muhl.
caroliniana, Walter.
cracca, Linn. Tufted vetch
Vitis aestivalis, Mx. Summer grape
riparia, Mx. Odoriferous grape
Viola blanda, Ww. Smooth violet
canadensis, Linn.
cucullata, Aiton. Blue violet
muhlenbergiana, Genging. Slender violet
ovata, Nutt.
pedata, Linn.
pubescens, Aiton. Yellow violet
rostrata, Muhl. Beaked violet

X

Xanthium strumarium, Linn. Clot burr
Xanthoxylum fraxineum, Ww. Prickly ash
Xylosteum ciilatum, Pursh. Twin berry
Xyris caroliniana, Walter. Yellow eyed grass

Z

Zizania aquatica, Lambert. Wild rice, Wild oats
Zizia aurea, Koch. Meadow parsnip
cordata, Koch. Alexanders
integerima, D. C.

Abbreviations of authors' names.

Bw. ..... Bigelow.
D. C. ..... DeCandole.
Lind. ..... Lindley.
Linn. ..... Linneaus.
Mx. ..... Michaux.
Nutt. ..... Nuttall.
Muhl. ..... Muhlenberg.
P. de B. ..... Palisot de Beauvois.
R. & S. ..... Roemer & Schultes.
Ww. ..... Wildenow.

[No. 3.]

Report of S. W. Higgins, Topographer
To Douglass Houghton, State Geologist, Michigan:

Sir—I herewith present a summary of the proceedings of the department which you did me the honor to place under my charge, with such facts in relation thereto as have been deemed of importance.

It is fortunate for the success of our undertaking, that in the new states the surveys of the general government have superceded the necessity of a large expenditure of time and funds in developing the surface of the country, by means of trigonometrical surveys. In order, therefore, to determine what strictly belongs to this branch, it was presumed that the information which might be obtained by referring to the several land offices, would prove sufficient.

It was thus my first object to make copies of all the records in the state, and collect from every source all the information in my power. For that purpose, after commencing with the Detroit land office, I proceeded to Flint; from thence to Ionia and Kalamazoo, and lastly to Monroe, where this part of my labors terminated, having obtained copies of 763 townships. These I set about compiling immediately into counties, connecting the sectional lines and streams. Copies of the counties, on a lineal scale of two miles to the inch, as well as separate townships on an enlarged scale, have been used by the geographical corps successfully in their explorations, for the purpose, not only of noting the geology in detail, but of delineating the true course of the smaller streams, the extent of swamps and marshes, public roads and improvements. Incorrectness will not be owing to the want of labor or attention bestowed, and from the materials in progress of collection, a certainty arises of a more correct execution of the maps to be made hereafter, than of any heretofore constructed.

It is to be regretted that there are so few statistics of the lakes. Many of the particulars which I have inserted appear indefinite for the want of more certain data; particularly their depth. In general, too much is left to conjecture, and until the necessity is urged upon the general government for a thorough hydrographical survey, and accurate descriptions of every part of them, losses and disappointment will check the ardor of enterprize. Much of the destruction of property may be charged to the want of charts, and the losses of a single year will amount to far more than the cost of an entire survey. A commencement of such a survey was made when Gov. Cass occupied the war department, but ceased at the end of two years having extended from the foot of Lake Huron to Middle Island.[30]

For a description of our topographical location, data were readily obtained from the records of the public works in the

[30]This survey simply included meanderings.

adjoining states. Their various public improvements have led to the exploration of every point of importance, and from a comparison of these points, with the records of our own public works, the true position of every required place on the southern portion of the peninsula may be relatively known.

Topographical location of Michigan

The topography of the state of Michigan, when viewed in relation to its exterior position, being separated by a natural boundary of rivers and lakes on the east and north-east from Upper Canada, from Illinois and Wisconsin on the west and south-west, and from Ohio and Indiana on the south, or only in reference to the space included within its own political and isolated boundaries, presents many peculiar features.

Lake Michigan on the west and north-west, Lake Huron, the river and lake St. Clair, the straits of Detroit, with the west end of Lake Erie on the east and north-east, enclose a peninsula forming a cone, of which the straits of Mackinaw is the apex, the south line or base being one hundred and seventy-four miles east and west, and the length north and south three hundred miles. With this extent of coast, the number of large rivers, and the infinity of small interior lakes, gives the utmost facilities to internal navigators, add to this the superior quality of the soil, its easy tillage, the heavy and abundant crops, and perhaps the whole is not surpassed by any section of equal extent on the surface of the globe.

The northern or upper peninsula belongs to a higher level. Beginning at the eastern end of Lake Superior, and running southerly along the Sault de Ste. Marie's river, it lies nearly at right angles with the southern or peninsula proper, and separated from it by a part of Lake Michigan and Green Bay, as far as Menomone river. It thence takes a northwest course to Montreal river, from the mouth of which, it follows the

southern shore of Lake Superior to the place of beginning; presenting an irregular and nearly isolated form, varying from twenty to one hundred and twenty-five miles in width.

Michigan, with the states west and southwest, are designated by geographers, as laying [sic] west of the great dividing ridge which determines the course of the rivers falling into the Atlantic on one side, and the Mississippi on the other. This Appalachian ridge, rising in Alabama, runs north-east, varying in altitude, to the gulf of the St. Lawrence, in many places spreading out into broad mountainous districts of thousands of square miles in extent. These districts being occupied by subordinate ridges, are often cut through by rivers, causing depressions, or valleys of corresponding depth. If, however, in, tracing the continuation of the great ridge, across the St. Lawrence to Labrador, it should be found that the same system continued, then the important fact would be elicited, that it had been cut through by that river, the only occurrence of the kind, from its source on the south, to its termination in the north. The Potomac, the Susquehanna and the Mohawk rivers have their sources on its eastern declivity. The lowest pass across the state of New York on the line of the Erie canal, is 565 feet above tide water; the "medium height, however, a few miles south, commencing at Catskill, on the Hudson, and terminating at Portland harbor on Lake Erie, is thirteen hundred feet, presenting no height less than nine hundred and eighty five feet, and the greatest twenty-one hundred and forty-four feet. With these and other surveys, it has been ascertained, that a water communication could not be made across the country south of the state of New York."

Further south the elevation is no where less than twenty-four hundred and seventy-eight feet above the ocean. The Round Top at Catskill mountains, is thirty-eight hundred and four feet, and the High Peak, thirty-seven hundred and eighteen feet above tide water. The western part of the state bordering on Lake Erie, embracing Chautauque and

Cattaraugus counties, Warren and McKeen counties of Pennsylvania, and the country southward, are occupied by a mountainous ridge: "Chautauque lake, the largest sheet of water on this table, is twelve hundred and ninety-one feet above the level of the ocean, and seven hundred and twenty-three feet above Lake Erie, though only nine miles distant: its discharged waters descend to the ocean, along the western declivity of the Appalachian range, through the Ohio and Mississippi rivers. The lowest pass to the east over a swell of land near Cassadaga outlet, in Chautauque county, is seventeen hundred and twenty feet high, and another pass on the same swell, nineteen hundred and seventy-two feet. The lowest niche in the height of land, between Elm and Little Valley creeks, in Cataraugus county is seventeen hundred and twenty-five feet, and between Little Valley and Big Valley, the lowest pass is twenty-one hundred and eighty feet above the level of the ocean. Franklinville has an elevation of fifteen hundred and eighty feet, and Angelica fourteen hundred and twenty-eight feet, although both are situated in valleys. This height of land extends close to the shores of Lake Erie, as it may be seen that the Allegany, a tributary to the Ohio, rises within four or five miles of the lake."

To the north this ridge gradually declines, until near the southern shore of Lake Ontario. Seven miles north of the cataract of the Niagara, it takes its last step to the margin of the lake. The ridge of rocks which forms this step continues eastward, and passes round the border of the lake, being of a uniform elevation of three hundred and nineteen feet; causing not only the cataract of Niagara, but also those of Genesee, Oswego, and the Black rivers. It thence unites with the more elevated spurs of Chateaugay, south of Montreal, forming the eastern boundary of the great basins of Lake Erie and Ontario, and giving the direction to the course of the St. Lawrence river through its whole length.

From the foregoing remarks, it is observable that the great basins or depressions of these lakes, are the abrupt terminations of the mountain range, and that we fall immediately into an extensive district, different in its topographical features, the peculiarities of which belong only to the region of the great lakes which bound the principal part of the northern frontier of the Union.

Leaving Chautauque county and passing around the south shore of Lake Erie, this ridge falls off to the southwest, curving towards Iroquois county, in Illinois. It gives rise to the Muskingum, Sciota, and Miami rivers, in Ohio, and to the Wabash, in Indiana, on its southern declivity, and to Maumee, emptying into Lake Erie on its northern declivity, while a small swell approaches the south bend of Lake Michigan, giving rise to the Illinois and its tributaries. The height of this ridge at the Portage summit, in Akron, thirty-eight miles south of Cleveland, on the line of the Ohio canal, is three hundred and ninety-five feet above Lake Erie, and nine hundred and sixty-three feet above tide water, and the deep cut twenty-eight miles east of Columbus, is but seventy-two feet less; at Portsmouth on the Ohio river, where the canal terminates, the elevation is four hundred and seventy-four feet above tide water, and ninety-four feet below Lake Erie. At the summit of the Maumee canal, at Fort Defiance, it is ninety-eight feet above the lake. It then falls to seventeen feet west of Chicago on the line of the ship canal, thence it pursues an uninterrupted course northward to the Portage at Fort Winnebago, between the Wisconsin and Fox rivers, an elevation of one hundred and twenty-one feet above Green Bay, and one hundred and thirty-four above Lake Erie.

At this point the Wisconsin river, after flowing one hundred and seventy miles from its source in the north, suddenly turns to the west, and falls into the Mississippi near Prairie Du Chien, one hundred and sixty miles; the Fox river, rising to the east, runs westwardly, approaching it within eighty-two hundred feet, and turning, takes its course again

eastwardly, and falls into Green bay. The surface of the water in the Fox is usually three feet lower than that in the Wisconsin, but in time of floods, passages are made from one to the other in boats. The following table will show the elevation of this summit above Lake Michigan and Green bay, the distance by the military road being one hundred and twenty-four miles.

	Feet.	Descent.
From Portage to Lake Winnebago	.....	30
Winnebago Rapids[31]	10.5	40.5
From Winnebago Rapids to Grand Chute	3	43
Rapids Grand Chute[31]	25	68
Fram Grand Chute to Little Chute	6	74
Rapids at Little Chute[31]	1.5	75.5
From Little Chute to Grand Cacalin	5	80
Rapids at Grand Cacalin[31]	31	111
From Grand Cacalin to De Perre	3	114
At De Perre dam and level Green Bay[31]	6	120
		121 ft.

The same swell continues to rise with about the same uniform degree of elevation, approaching the northern peninsula of Michigan, until it can be seen from Lake Superior, bounding the southern horizon. It divides the waters that run north into that lake, and those of the south into the Mississippi, Green bay and Lake Michigan, one of the most elevated ridges receiving the appellation of Porcupine Hills. Swells branching off to the eastward, and having their bases washed by the waters of the lake present mural precipices, and assume different names. Those of the Pictured Rocks are said to be the most imposing. Some of these cliffs are three and four hundred feet high. From the Porcupine Hills, the country slopes eastward to the Sault de Ste. Marie, the outlet of Lake Superior; this river is obstructed by a rapid 4,500 feet long, with a descent of eighteen feet.

[31]Ascertained by instrumental survey.

Table of the height of Lake Superior, with the intermediate lakes above, and their distances from tide water.

Route.	Miles.		Feet.	
St. Lawrence river up to tide water	.....	450	.....	.....
Level Lake Ontario	200	650	.....	232
Level Lake Erie	175	825	333	565
Level Lake Huron	340	1165	13	578
Level Lake Michigan	.....	.....	.....	578
Level Lake Superior	240	1405	18	596
West End Lake Superior	490	189	.....	.....

From the above data we infer the following curious fact: that if a barrier eighteen feet high existed across the foot of Lake Huron, near Fort Gratiot, Lakes Huron and Michigan would rise to a level with Lake Superior; or if a similar barrier was placed of thirty-one feet, across the foot of Lake Erie, at Buffalo, the singular result would follow that four of the great lakes would become one uniform level and merged in one immense inland sea.

By an examination of the foregoing table, we see a striking peculiarity of this region of "broad rivers and streams"—its vast extent—commencing at the gulf of St. Lawrence and extending in a southwest direction up that river; thence into the basin of Lake Ontario, at an elevation of 232 feet above the ocean, thence again rising by the Niagara river and cataract, 333 feet to the level of Lake Erie; (the first in the central subdivision, including Lakes Huron and Michigan, of the great basin,) forming an angle at the western end of that lake in the estuary at the mouth of the Maumee river, it thence runs nearly north through the straits of Detroit, the lake and river St. Clair, into Lake Huron, rising 13 feet; thence by a northwesterly course, through the straits of the Sault de Ste. Marie, rising 18 feet, to the west end of Lake Superior, a distance of 1,895 miles. The whole depression contains an area of 400,000 square miles, 94,000 of which is occupied by water, still leaving an extent sufficient to sustain a population of more than seventy millions of inhabitants.

The following will show, in a condensed form, estimates of the mean length, breadth, depth, area, and elevation of the several collections of water:

	Mean Length. Miles.	Mean Breadth. Miles.	Mean Depth. Feet.	Elevation Feet.	Area in square miles.
Lake Superior	400	80	900	596	32,000
Green Bay	100	20	500	578	2,000
Lake Michigan	320	70	1000	578	22,400
Lake Huron	240	80	1000	578	20,400
Lake St. Clair	20	18	20	570	360
Lake Erie	240	40	84	565	9,600
Lake Ontario	180	35	500	232	6,300
River St. Lawrence	.....	.....	20	.....	930
					94,000

Michigan occupies a central position, between the extremes, and uniting with the upper division of the St. Lawrence basin, having an area of forty-three thousand five hundred square miles on the lower, or peninsula proper, and twenty-seven thousand square miles on the upper peninsula; making an aggregate of seventy thousand five hundred square miles.

The Lakes and Lake Coast

These constitute a prominent feature, and must be of great and increasing interest connecting the agricultural with the commercial enterprize of Michigan. As no state with a location so distant from the seaports, has done more in the same short period to develope the advantages to be derived from its internal resources, none can be in a situation better to reap the advantages arising from an extended inland coast.

If the distance by meanders of the shore of the lakes, and indentations of the bays, were to be made the standard for the length of the coast, it would amount to more than twice that of another, run without regard to the sinuosities of the shore.

The exact distance from the foot of Lake Huron, (near Fort Gratiot,) at a point where the north line of township number six north, and range number 17 west, intersects the water, to Middle Island by meanders, is 345 miles, including Saginaw bay. The same distance on a direct line is only 143 miles. Thence to Mackinaw, 97 miles; but by meanders, including the False and True Presque Isles, the distance would be increased to 150 miles; making a total by meanders of 495 miles; and by a direct line, 240 miles.

If the eastern shore of the peninsula appears so irregular and deeply indented with bays and harbors, the western is not less so, particularly in the northern part. The difference will be proportionally greater, as the Little and Grand Traverse bays are larger, excepting Saginaw bay, than the largest bays on the eastern side; but as a small part only of the western shore has been surveyed, the subject will not admit of a more extended notice at this time.

Many doubts have heretofore existed in relation to the number and convenience of harbors. A minute examination of the shores, has, however, removed much of the prejudices against the navigation of the lakes, and there is probably no line of coast of equal extent, (being 700 miles,) that will, with inconsiderable improvements, furnish a greater number of good harbors. Much of the apprehended danger has arisen, therefore, from ignorance of these facts, and the localities of the numerous sheltered bays which would afford protection at all seasons; and as but few if any attempts have been made by actual navigators to explore for themselves, and being without charts, it is no wonder that representations of danger should have obtained, and the dread of shipwreck on an apparently desolate coast, magnify in a great degree, the fears attendant on crossing these inland seas.

Depth of the Lakes

The depth of the lakes has been a subject of speculation, from the earliest period of their discovery by Europeans.

Tables have been constructed, and the areas and contents of each, endeavored to be ascertained. Errors have been made in these as well as in their elevation above the ocean; in the latter case, however, little is left to conjecture.

Lake St. Clair, an expansion of the straits between Lakes Huron and Erie, 18 by 20 miles, is much the shallowest, the average depth being only 20 feet. Lake Erie does not exceed 84 feet. An ordinary storm disturbs its bottom, and its waters appear turbid. These lakes may be considered as receiving the detritus brought down by the rivers flowing into them, and deposited there. This in particular is apparent, around the head of Lake St. Clair, where alluvion islands are constantly forming, and in spring choke up the numerous channels at the mouth of the St. Clair river, extending in the form of a delta far into the lake. The same remark may be made in respect to the west end of Lake Erie, where detritus extends some miles from the mouth of Maumee river; the channel is often devious, and a prevailing westerly wind reduces the lake to less than one fathom.

Lakes Michigan and Huron have undoubtedly the deepest chasms. Receding from the shore, their waters deepen uniformly, and there exist no central shoals or islands, showing in any manner a broken or alpine formation at their bottoms. It is only in the straits of Mackinaw, and above and around the Georgian or Manitou bay of lake Huron, that islands and shoals make their appearance. The channels among these islands, however, are only chasms through rocks, caused by abrasion from the waters of the lakes. Soundings have been made to the incredible depth of eighteen hundred feet, without reaching the bottom, and the most experienced ship masters do not hesitate to assert the average depth to be more than one thousand feet. Lake Superior, though larger, cannot be considered deeper than the others, for reasons already assigned. It abounds with islands, many of which are large; Isle Royal is one hundred miles long. Primitive masses of rock lie disrupted above and below its surface, in

every direction, and a permanent impression is left that a chasm, shapeless in its exterior, as well as its interior dimensions, fed by springs and tributary rivers, are the great features of this lake, at a depth of nine hundred feet.

Mountain districts, as has been heretofore observed, may be cut through by rivers, causing deep vallies [sic] and depressions, but no where on the continental surface of the globe can be found so deep chasms as the basins of these lakes. Though elevated 596 feet above, their bottoms are more than 400 feet below the level of the ocean. Their superficial area is 94,000 square miles, and they contain 11,300 cubic miles of water; a quantity more than half of all the fresh water on the earth.

Interior Peninsula Lakes

Neither is the subject of the lesser interior lakes on the peninsula, so far as their number and magnitude are ascertained, to be overlooked, forming as they do by their frequency a great contrast in the topography of this, to that of the other states.

From the Ohio and Indiana line on the south, up to range line number seven north, including all south of the northern railroad, an extent of 9,688,320 square acres, there are 1,425 of these lakes, occupying areas of from one to thirty-five hundred square acres each. Their waters are remarkably cool and transparent, and give to the landscape a highly picturesque appearance. To apply the principles of hydrography in ascertaining their aggregate extent, becomes the more difficult, since, in addition to their great number, no two are of the same dimensions. The following, however, will be found to approximate the truth: allowing each lake an area of 160 rods square, we shall give to the whole 228,000 acres, an extent equal to nearly ten townships, and somewhat larger than Lake St. Clair; and a proportion of about one acre of water to every thirty-nine of dry land.

All the rivers in the state have their sources in groups of these lakes, and they are the fountains of the unremitting volumes that flow through the thousand channels of our streams. While the rivers of neighboring states have measurably disappeared during the drought of the last summer, and caused derangement in their commerce, ours have suffered comparatively little diminution.

Periodical Rise and Fall of Water in the Lakes

This interesting question has given rise to a variety of curious speculations. The inference drawn from the following data, it is presumed, will not be altogether inconclusive.

Calculations may be made sufficiently accurate to determine nearly the amount of surface drained, "and if our climate shows a successive series of cold and moist years, and a series of warm dry ones, mutually following each other," variations in the volume of water, cannot but necessarily be great.

Taking into our account only the central and upper divisions of the St. Lawrence valley, from Niagara, to the northwest angle of Lake Superior, embracing all the country whose streams are tributary to the lakes, we have, by the following table of sections, 248,755 square miles of surface, besides that of the lakes.

The floods in Lake Ontario are generally the highest by about two feet, and for the obvious reason, that it receives the successive accumulation of all the other lakes, from the Niagara to the head of the St. Louis river.

From the year 1814, we can speak with some degree of confidence of the rise and fall of these waters. During that year, the upper lakes were full. This was the case in 1815, with the central and lower lakes. In 1819 and 1820, the water is said to have been at an unusually low ebb in the same lakes.

Superficies Drained by the Central and Upper Divisions of the St. Lawrence Basin

	Medial length.	Medial breadth.	Area in square miles.
Peninsula E. and S. E. of Lake Huron, and N. of Lake Erie, from Iroquois bay to Niagara	123	88	10,455
N. and N. E. from Iroquois bay to the Ottawa river	300	200	60,000
N. E. of Lake Superior, from Mackinaw to Nipigon river	320	60	19,200
N. W. of Lake Superior, from Nipigon to St. Louis river	310	55	17,050
S. W. and S. of Lake Superior, from St. Louis river to Desert lake and Portage	300	200	60,000
W. Side Lake Michigan from Portage to head Des Plaines river	150	100	15,000
Peninsula betwen Lakes Michigan and Huron, and west end Lake Erie	325	174	56,550
South of Lake Erie to Niagara	300	35	10,500
Add area of Lake Superior	32,000		
" " Green Bay	2,000		
" " Lake Michigan	22,400		
" " Lake Huron	20,400		
" " Lake St. Clair	360		
" " Lake Erie	9,600		86,760
Total square miles			335,515

The difference in the time of the apparent rise between the upper and lower division may be accounted for on the principle that the largest bodies of water are on the upper level, and as these are discharged, the lower division would be comparatively high, while the upper would be reduced to low water mark.

From 1820, the water again began to rise, and continued to increase, until 1828; since which time, A. E. Hathon, Esq., civil engineer of Detroit, has given the subject particular attention. His first observations were taken at the old hydraulic works, at the time when the pipes were being laid for furnishing the city with water from the Detroit river; he has since transferred it to the top of the water table of

the tower, at the new hydraulic works. The surface of the river at the time of the transfer, August 21, 1838, was 3.21 feet below that base: this will serve as a reference for the future.

It appears from his journal, that the water was low in the spring of 1830, having fallen about two feet since 1828. In June following, it had again risen two feet, or to the level of 1828. From that time, its rise was gradual, until June, 1836, at which time it was found to have attained the height of one foot eight inches. In June, 1837, it rose seven inches. In June, 1838, nine inches, and on the 21st August following, three inches; making the rise 3 feet 3 inches since June 1830, and 5 feet 3 inches since March in the same year.

Table Showing the Rise of Water from March, 1830 to Aug. 1838

	Feet.	Inches.	Rise.
June, 1830			2.0
June, 1836	1	8	3.8
June, 1837		7	4.3
June, 1838		9	5.00
Aug. 21, 1838		3	5.5

Some allowance ought to be made for the sudden rise of two feet from March to June, as from observation, it is believed that winter has the effect of producing a partial decrease.

On the 21st November, 1838, the water had fallen 12¼ inches and on the 2d February, 1839, 3 feet 8 inches.

Many conclude that the present high flood is greater than has been known for at least a century, from the fact that orchards have been killed along the St. Clair and Detroit rivers, in consequence of the lands being overflowed. In some instances, forest trees have been destroyed by the overflowing water, and upon counting the concentric circles in sections

obtained from their trunks, they were found to exceed a hundred.

In order to estimate the enormous accumulations of water during the time of the highest flood, and which is discharged through the river, it will only be necessary to refer to the table where 5¼ feet appears to be the maximum of the rise. A transverse section of the river taken opposite Detroit, where it is contracted to 52.80 of a mile of this depth contains 18,018 cubic feet; and allowing the current a velocity of one mile an hour, which is known to be less than its ordinary current, there would be discharged 95,135,040 cubic feet per hour, or 1,585,558 cubic feet per minute, an amount sufficient to supply fifty-eight canals of the dimensions of the Clinton and Kalamazoo,[32] or thirty-five of the grand Erie canal, and more than sixteen times the amount contained in the Cedar river, and Sycamore creek, Ingham county, Deer creek and Grand river, Eaton county, Shiawassee river, Livingston county, and Rabbit river, Allegan county.[33]

We are not prepared to say that there are sixteen times as many rivers, (as those above enumerated,) at the north, which have changed their course, and discharge in directions contrary to their former ones, thus filling the basin of Lake Superior, and causing the periodical rise of the lakes; nor is it reasonable to suppose that rivers, discharging so great a quantity can be found in that region. We must, therefore, look for the cause to the quantity of rain which has fallen, and to the melting of the snow in spring, upon the immense surface drained by these lakes.

Rivers

Streams receiving the appellation of rivers in the state are numerous. This name, however, is applied to none unless of

[32]27,313 cubic feet is required per minute, for this canal. See rep. of J. Hurd, engineer.
[33]These rivers discharge in the aggregate, 98,846 cubic feet per minute, at the places designated. J. Hurd's report.

sufficient magnitude to be considered worthy of meandering on both sides; accordingly, instructions to that effect have been given by the Surveyor General to his deputies, in the prosecution of the government surveys. The Grand, Muskego and St. Joseph, will bear a comparison in length with many of the western, and no small number of the eastern rivers, of the first and second class. Their width and depth are not in proportion to their length, arising from the fact of their uniform descent. This characteristic will apply to all the other streams on the peninsula. They are unbroken by cataracts, and but little obstructed by rapids. The number in the surveyed part, and discharging into the lakes, is twenty; —of these the Grand river is the largest.

This river rises in Hillsdale and the south part of Jackson counties, in a cluster of more than fifty lakes, that interlock with the Kalamazoo and St. Joseph, each emptying into Lake Michigan on the west, and with the Raisin, which empties into Lake Erie, on the east. These, with the Little St. Joseph, St. Joseph of Maumee, and Tiffins, or Bean creek, running south, have their sources on the highest table land in the southern half of the peninsula, being an elevation of six hundred and forty-six feet above Lake Erie. From its source in a northerly direction to Jacksonburgh, is twenty-five miles; its level here being three hundred and twenty-five feet above Lake Michigan. From Jacksonburgh, it is fifty-three miles to Red Cedar river, thirty to Looking-glass river, and eighteen to the Maple river. At this point its elevation is fifty-six feet above the lake, where it takes a westerly course of fifty miles to Grand rapids, and forty more to its mouth, making its entire length two hundred and sixteen miles. It conveys the surplus water of 2,949,120 square acres. There are many other large tributaries besides those above mentioned, which it receives from the north—among these are the Flat, and Rogue rivers, no inconsiderable streams. Its width the first forty miles from its mouth is 800 feet, and for fifty miles further, to Lyons, on the Maple, it is 500 feet. In spring,

floods raise the river about ten feet, overflowing and enriching its valley, which is densely covered with a heavy and beautiful growth of forest trees.

The St. Joseph has for its source more than twenty-five lakes, and as before mentioned, has its origin in Hillsdale and Branch counties; it runs a northerly course, afterwards passing to the southwest, and crossing the south boundary of the state, enters Indiana; again curving northwardly, it re-enters this state and falls into Lake Michigan, receiving many large tributaries, among which are the Paw Paw, the Dowagiac, Elkhart, Prairie, Pigeon and Fawn rivers.

From its mouth to the line of Indiana, the distance is forty-eight and a half miles, at a level of sixty-eight and a half feet; after running forty-three miles in Indiana, and at an elevation of ninety feet, it re-crosses the state line; the distance to Three Rivers is twenty-three and three-fourths miles, rising thirty-five feet, thence twenty-six and one-fourth miles to Sturgeon lake, and twenty and a half to Union city, making the whole distance one hundred and sixty miles from its mouth to this place, and its height above Lake Michigan two hundred and eighty-five feet; the entire length of the river is two hundred and eight miles, its width is nine hundred feet at its mouth, and carries the surplus waters of 2,327,040 square acres.

The Kalamazoo river drains nearly all the remainder of the surface on the western declivity, (situated between the Grand and St. Joseph rivers above described,) or about 1,382,400 square acres. Its tributaries are not many or large; its average width is about two hundred feet; its source is in a group of 20 lakes. Farwell's lake is six feet above the source of Grand river, though hardly forty rods distant, and so near do the rivers rising on this plateau approach each other, that the waters flowing east, west and south, might easily be made to mingle at this point. Its course is more direct than either of the others mentioned.

The distance from its mouth to Allegan is thirty-eight miles, with a current of three miles an hour; thence twenty-five miles to Kalamazoo, where it is one hundred and forty-eight feet above the lake; thence to Albion, at the Forks, thirteen miles rising nine feet making a distance of one hundred and sixteen miles, and at an elevation of three hundred and forty-five feet. From the Forks to its source is thirty-four miles; its entire length is therefore one hundred and fifty miles.

The rivers discharging on the eastern coast of the state, within the surveyed district, have a less volume, and may be described together as having similar features, or if there be an exception, it is in the length. The length of all is abridged, however, by having a space to traverse only of about forty to sixty miles; the dividing ridge being so much nearer the eastern than the western side of the peninsula.

The river Raisin heads in a series of fifty lakes, the nearest of which is but a few rods from the head of Grand river. Its whole length may be computed at 85 miles.

The head waters of the western branches of the Huron also rise near those of Grand river, while its eastern sources inosculate with the Clinton. This river and the Clinton have their sources in by far the greatest number of lakes; they are no less than 200, and some of them large, embraced in the area of Oakland, Livingston and Washtenaw counties.

The Saginaw river receives the discharged waters of the Cass, Flint, Shiawassee and Tittabawassa rivers, twenty-five miles from its mouth. These rivers with their tributaries descend from every point of the compass—the Tittabawassa from an unsurveyed district in the north; the Shiawassee from the western declivity of the summit in Oakland county in the south; the Flint and the Cass from the summit of the same swell, in Lapeer and Sanilac counties, on the east and southeast. Their average length is ninety miles.

United States' Surveys

These are progressing with rapidity, and if continued during the next two years, the whole peninsula will have been surveyed. The highest point to which they have been carried is town 26 north, embracing 180 townships. The facilities are reported by the surveyors, to be as favorable as those of any other new country, and equal to those of earlier surveys, for carrying forward their work; maps of these surveys have been collected, in part, for the future use of the geological department. An inspection of them exhibits in the general outlines, a similarity to the southern portion of the state; the variety and number of small lakes, the great length of the principal streams, with an undulating surface, are the principal features.

It is understood that contracts will be made for commencing on the upper peninsula, at the opening of next season, and it is probable that the standard lines will be run, and the completion of the eastern half, from Chocolate river on Lake Superior to the head of Green bay, during the same time.

The lands heretofore held in reserve, and which are by treaty to be sold, have been subdivided. These reserves are among the best locations in the state. The avails, after deducting the surveys and other expenses, go to the Indians.

Little will be left after the survey of the state shall have been completed, requiring adjustment. The simple rectangular method adopted by the general government, first, in subdividing the country into townships of six miles square, and these again into sections of one mile, give a character of mathematical accuracy which is excelled by no other system; the width and course of all streams crossing the lines, and their distance from the nearest corner, are noted, as well as the entrance into and distance across marshes and swamps; it will therefore require but little attention to draft the streams not meandered, as well as the marshes, in the interior of the sections, by personal examination, with sufficient accuracy for correct topographical maps.

Levels

Information of the most valuable kind has been obtained from the Board of Commissioners of internal improvement; copies of the surveys of the central and northern railroads have been furnished, and by a resolution which passed that board in 1837, they will continue to furnish copies of all the surveys connected with the public works; these, with the surveys of the different railroad and canal companies, will leave but few points, the elevation or depression of which may not be known, either in reference to the lakes or the ocean. Vertical sections connected with correct lineal drawings, are appreciated by the geologist, and have an interest with him as great as with the engineer.

Accompanying this report you will receive a map of the state made by your direction for general reference. Upon the same sheet, projections of all the levels which have been made across the state, are constructed. A slight inspection will show at once the vertical relation of almost every important point throughout the territory included in the survey. The surface of Lakes Huron and Michigan is made the plane of reference; these are 578 feet above tide water.

By a reference to the heights, it appears that there is a swell of land, which may be called the true *water-shed*, running from Point aux Barques south forty-five degrees west, and passing out of the state into the northeast corner of Indiana, about equi-distant from Lakes Erie and Michigan. It attains its greatest elevation in Hillsdale county, seven miles east from Jonesville, where it is 633 feet above the plane of reference. Its summit on the central railroad, at the division line between Jackson and Washtenaw counties, fourteen miles east of Jacksonburgh, is 437 feet. In the village of Pontiac, in Oakland county on the summit level of the Clinton and Kalamazoo canal, it is 336 feet. It then again rises, and at the head waters of Belle river, in Lapeer county, is 414 feet. From this point it gradually falls off, and with

a few rills descending on its north and eastern slope, sinks to the level of the beach of the lake. This swell will present but few elevations above the actual surveyed levels, exceeding fifty feet, and these knobs, where present, are located without design, and without uniformity of range.

On the line between Oakland and Livingston counties, a branch diverges to the northwest, giving rise to the Red Cedar, Looking-glass and the Maple rivers, on its western declivity, while the Shiawassee rises at the point of divergence, and runs northwardly parallel to its eastern side. The lowest pass across this swell is 95 feet above Lake Huron. Leaving this point and ascending to township 10 north, of range 5 west, its course is changed to the north, and it rises to its greatest elevation at the sources of the Maskego river in Lake Otisco, in town 22 north. From an inspection of the map an apparent design appears to have marked the future communication between Lakes Huron and Michigan, from the broad and deep indentation of Saginaw bay over this narrow and low pass.

From the dividing swell, the country lies in one plane on each side, inclining gently and uniformly to the margin of the lakes, with the exception of a slight corresponding elevation on the western side of the state. This may be traced from the great bend of Grand river to where it crosses the Kalamazoo west of that village; thence curving with the shore of the lake, terminates at the South Bend, where it diverts the St. Joseph river through a part of Indiana. Its average height at Grand river is 80 feet, 200 at Kalamazoo, and 75 at South Bend, above the level of the surrounding country. It need not be stated that the interior peninsula lakes partake of the highest elevation, when reference is had to their being situated at the sources of all the rivers, and that the summit in Oakland and Livingston counties abounds with the greatest number.

From tables in which I have collected the elevation of places, I have selected a few remote from each other, which may

serve to show the uniformity of the surface generally. Conclusions from this table cannot be drawn, however, in detriment to the healthy and rapid, and not unfrequently precipitous flow of all our streams.

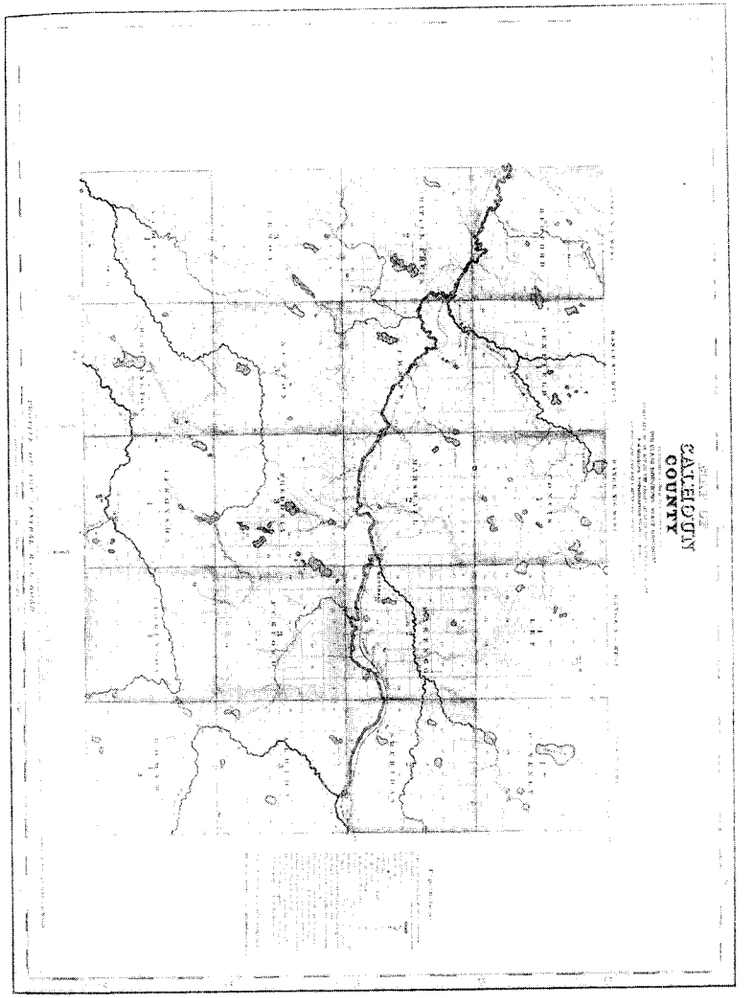
Outlet of Grass lake, Jackson county,	377	feet
Village of Barry, " "	362	
Head of Spectacle lake, Calhoun county,	373	
Head of Mill creek, St. Clair county,	368	
Kalamazoo river at Albion, Kalamazoo county,	351	
Sandstone creek, Jackson county,	347	
Outlet Gillet's lake, "	354	
Village of Newberry, St. Clair county,	284	
West end Prairie Ronde, Kalamazoo county,	278	
Rice creek, near Marshall, Calhoun county,	280	
Honey creek, Washtenaw county,	266	
North Branch Raisin river, Lenawee county,	276	
Hasler's creek, Lapeer county,	265	
Geddes, Washtenaw county,	220	
Flint river, at Lapeer, Lapeer county,	238	
Huron river, Dexter, Washtenaw county,	232	
Old Fort Holmes, Mackinaw,	219	
Kalamazoo river, near Augusta, in section 35, town 2 south, range 8 west, Kalamazoo county,	187	
Branch St. Joseph, 30 miles south section 35 town 6 south, same range, St. Joseph county,	187	
Kalamazoo river, Kalamazoo village,	154	
Thirty miles south southern railroad crossing, St. Joseph river, St. Joseph county,	138	
Shiawassee river at Owasso, Shiawassee county,	145	
Fort Mackinaw, Mackinaw,	150	
Cliff. Robinson's Folly, Island Mackinaw,	128	
Ypsilanti, Washtenaw county,	130	
Bank of Lake Michigan, New Buffalo, Berrien county,	100	
Huron river, at Ypsilanti, Washtenaw county,	100	

Paw Paw river, Lafayette village, Van Buren county,	106
Brush creek, near Mason, Van Buren county,	76
Bank of Galien river, ten miles east of New Buffalo, Berrien county,	74
Stoney creek, crossing northern railroad, Ionia county,	82
Mouth Maple river, Ionia county,	56
Bass river, crossing northern railroad, Ottawa county,	56
St. Joseph river, at Bertrand, Berrien county,	53
Half way house, Wayne county,	54
Crossing southern railroad four miles west Monroe, Monroe county,	49

A fact may also be inferred from the collated levels, that the average height of the peninsula is 160 feet above the surface of the lakes.

Maps, &c.

Much of my time has been occupied, as will be observed, in making collections preparatory to the final publication. They are intended to embrace the geology as well as the topography and geography of every section of the state. Twenty counties are in a state of great forwardness, five of which may be said to be finished in detail, viz: Wayne, Monroe, Jackson, Eaton and Ingham. It was thought unimportant to enter into a description of these in this report, as during the next year a large number will be added, and a report including the whole will then be made. Drawings will also be given of such remains of ancient works and tumuli as are scattered through St. Joseph, Kalamazoo and some other counties. These are more rare in this, than in some of the states south and west; sufficient evidences remain, however, of a former population, remote to the oldest traditions of the inhabitants. The time is not distant when the curious will be gratified with the system they pursued, and the facts it unfolds relative to



the uses for which so much labor has been expended by an ancient people, upon the different structures found in the west. Public attention is being directed to their development, and when the position and dimensions of those that remain shall have been determined, elements for a history will remain, as perfect as may be collected in the absence in part of tradition or written documents.

Here let me publicly acknowledge the hospitable intercourse of the citizens of the state, and the polite regards of gentlemen in the different public offices, in affording every facility, and giving access to the records in their charge.

S. W. HIGGINS,

Topographer of the Geological Survey.

Detroit, 2d February, 1839.

[No. 4.]

Report of C. C. Douglass, Assistant Geologist

To Douglass Houghton, State Geologist:

Sir: I have completed the detailed survey of so much of the district which you assigned me, as is embraced in Ingham county, together with a portion of Eaton and Jackson counties. Much time having been occupied in tracing and examining the coal formation, in order to arrive at satisfactory conclusions as to the probable extent of this valuable deposite in the district, it is thought advisable to defer the report of a part of Eaton and the whole of Jackson county, until the work shall have been more nearly completed. The examinations of the coal district resulted in the collection of many important facts, some of which cannot be properly made use of until more extended examinations have been made. But it may be observed, that these have been sufficiently satisfactory to place beyond doubt the existence of this valuable substance

in sufficient quantity to be of much prospective value to the state.

The maps of the counties under consideration, have been found to be exceedingly incorrect, and in accordance with your instructions, I have been able to accomplish much towards correcting the numerous geographical errors upon the maps, now being constructed. These, according to your instructions, having been transferred to the topographical department, can only be generally noticed in this report.

One of the most prominent characters of the county under consideration, when compared with the more southern counties, is, its remarkable uniformity of surface. Although the whole country may be considered as gently undulating, it has no great irregularity of surface, except in those sections traversed by streams, where gorges, frequently of considerable depth, are sometimes found.

Occasionally some few isolated hills and ridges are seen, but they, with a few exceptions, are hardly worthy of notice. In township three north, range one east, a series of isolated ridges commences on section thirty-four, and extends in a northeast direction, across sections thirteen, twenty-three, twenty-four, twenty-six and twenty-seven, having an altitude of from twenty to eighty feet.

A second and nearly parallel elevation was noticed, commencing on section three, in the same township, and extending to section thirty-four, in the adjoining town, having an elevation varying from twenty to forty feet.

A third commences in the south part of Vevay, and extends in a northwest direction, nearly through the town, varying from ten to eighty feet in height. At the village of Mason, the Sycamore creek passes through a ridge of diluvion composed of stratified coarse sand and pebbles, slightly united by a calcareous and ferruginous cement.

About three-fifths of the county of Ingham consists of timbered land, while the remaining two-fifths are oak openings

and plains. That portion of Eaton county embraced in this report consists of timbered lands.

Timber

The timber upon the less elevated bottom lands extending along Grand river consists of sycamore, black ash, elm, black walnut, &c. Upon the inclined uplands, connecting the bottom with the table lands, a general mixture of the usual hard wood timber is found.

The table lands are mostly timbered with the varieties of oak, beach, maple, lynn, hickory, cherry and whitewood; with sycamore, butternut, black walnut and elm on the margins of the streams.

Ingham county occupies a very central position in the state, and possessing as it does a rich soil, valuable quarries of sandstone and extensive deposites of bituminous coal, it promises to become one of the most important counties in the state.

Soil

The prevailing soil of Ingham county and that part of Eaton county lying in township four north, ranges three, four, five and six west, is sandy loam and loamy sand over an extent of more than seven-eights of the surface. Limited tracts of a stiff loamy clay, with occasional hillocks and ridges of fine yellowish sand, occur, and were observed more especially near the small lakes and streams.

Beds of sand and gravel are sometimes seen to alternate with those of loam and marly clay in such a manner that a field of a few acres may exhibit almost every variety of soil, from a fine sand to a stiff marly clay.

The art of the farmer may be here put in requisition to modify the natural texture of the different soils, and fit them to receive nutritive and stimulant manures with the greatest advantage. The stiff heavy clays may be dressed with sand and the light soil with loam or clay, (marly where it can be

obtained,) with a view to transform the whole into a loam of such a texture as to make a pulverulent soil, and yet leave it sufficiently argillaceous to retain a desirable quantity of water. Yard manure, composts mixed with lime, ashes, and muck of the marshes and swamps, if thrown into heaps with quick lime and allowed to undergo a more perfect decomposition, would make a valuable manure for the light soils. Lime is essential to the fertility of the light soils, and as shell marl is within the reach of nearly every farmer, it being found in many of the lakes and marshes, no reason can exist why these light soils may not be made and retained of the most fertile character. The marl may be taken from the pit in the fall and winter or at any leisure season, and spread over the land in the same manner as fine yard manure. Experience must determine the quantity best adapted to each particular soil.

The clays of Ingham and Eaton counties may be employed to advantage on the light soils, for they will not only give consistency to the soil, but will also furnish the necessary lime.

Marshes and Swamps

Many extensive marshes exist in both Ingham and Eaton counties, and probably may be said to extend over an area of about one-ninth of the surface. Many of these marshes have originated from the stoppage of water in the streams, having been dammed by the beaver, which formerly existed in the country in great numbers.

Two marshes of this character commence near the south line of township two north, range one east. That on the west of the township, extends in a northeast direction nearly to the corner of town three, having a length of twelve miles and an average width of eighty rods.

The one on the east extends north two or three miles into the adjoining township, having a length of seven miles and an average width of half a mile.

A vegetable deposite of from one to eight or nine feet thick, frequently tremulous when wet, occurs in many of these marshes. This deposite is mostly underlayed by marly clay, which is sometimes covered to a slight depth with sand and gravel, and in some instances with shell and tufaceous marls. This vegetable matter, being imperfectly decomposed, forms a light fibrous peat.

A large majority of these marshes can be readily drained, and will, by proper culture, become fertile meadows or even arable lands. Many of them when filled with water are tremulous. Most of the swamps and marshes are covered with a luxuriant growth of sedge, tamarack and cranberry vines.

Springs and Wells

Most of the springs and wells in these counties furnish water containing the salts of lime, and constitute what is termed hard water. The country is generally well watered, though during the past season, owing to the drought, some portions were nearly destitute. Along the vallies of the streams and through the whole extent of the sandstone formation, water is abundant, rising to the surface in springs, and collecting in the low grounds, forming numerous small streams.

In the township of Onondaga the sand rock, occurs at various depths, and water is generally obtained at the surface of the rock, or by penetrating it a few feet. Many of the springs contain large quantities of carbonate of lime in solution, which, as the water comes in contact with the air, is deposited in the form of tufa or a fine pulverulent marl. When the quantity is small, the porous vesicular deposite, called tufa, is found, but when the water is abundant, or the springs rise in a level tract or swamp, it is deposited in the shape of marl.

The most copious springs of this kind are along Grand and Cedar rivers. Nearly all the small streams, as well as most

of the lakes and marshes, (which do not originate from beaver dams,) have their origin in springs.

The water of most of the springs noticed, aside from the lime it contains, is remarkably pure and limpid, but occasionally chalybeate springs occur. The springs last mentioned not unfrequently give rise to very limited beds of bog iron ore.

Streams

Grand and Cedar rivers are the two principal streams in Ingham county; the first watering only a small portion of the western townships, while the Cedar, entering on the east, completely traverses the country.

There are, besides these, numerous small streams, varying from a few links to sixty links in width.

Among the largest of these are the Sycamore, Willow, Mud and Deer creeks, and the east branch of the Cedar river.

It will be noticed by reference to the map, that all the streams have a bearing to the north, excepting the few north of the Cedar river.

These streams furnish the country with a tolerable supply of hydraulic power.

Marl

An extensive deposite of shell marl was noticed on section fifteen, township one north, range one west; occurring near the source of a small stream. It is chiefly in the state of a compact and beautifully white powder, containing an abundance of recent shells. The stream before noticed passes through an extensive marsh, much of which is underlayed by the marl, covered with peat and vegetable muck, of from two to six or eight feet thickness.

Marl also occurs in a basin shaped hollow, on section thirty-three, in the town of Leslie.

I was informed by Mr. Woodworth, that an extensive bed of marl occurs on section thirty-five, township two north, range one west.

Calcareous tufa was noticed at several places in the counties, but not in sufficient quantity to be of any practical value.

Bog Iron

Several deposites of bog iron were noticed in Ingham county, which, however, are of not sufficient extent to be of any practical value. These were in most cases noticed along the streams, outlets of marshes, and in connection with chalybeate springs.

The most extensive deposite observed in Ingham county, was on section eighteen, township three north, range two east, in the bank of a small stream. It consists of coarse and fine grains, forming masses in the soil, which is of a sandy loam.

A deposite of an argillaceous ochre, was noticed on section twenty-two, in the town of Leslie, covering an area of four square rods, and from a few inches to three feet thick. It is very unctuous, containing but a small proportion of sand and gravel. Mr. Woodworth informed me that he had made use of it as paint, and found it to answer a good purpose.

On section eleven, in the town of Stockbridge, was noticed a deposite several rods in extent, and from a few inches to one foot in thickness, varying from a deep to a light red color, unctuous, and containing sand and gravel in small quantity.

Another deposite was noticed at the outlet of a marsh, in the southwest corner of Onondaga.

Crag

On section three, township four north, range three west, in the bank of Grand river, sand, cemented with calcareous matter, occurs, and has been mistaken by the inhabitants for a ledge of sandstone. It has an elevation of fifteen feet, but

is not extensive. It is covered with a light colored clay soil. The sand from which the crag is formed is considerably extensive, and will afford a good sand for mortar.

Boulders

Primary boulders were noticed at numerous points in these counties, particularly along the streams, where they occur in great numbers.

Boulders occur more frequently upon the surface of the plains than on the timbered lands. They are not unfrequently seen in great numbers upon the summits of the most elevated hillocks and ridges.

On section thirty-one, township four north, range two east, several small angular boulders of lighth colored limestone, containing fossils, were seen.

Clay

Blue and variegated clays, inferior in quality, are not unfrequently met with in Ingham and Eaton counties. A variegated marly clay, of fine texture, was observed on the west side of Pine lake, and will afford an excellent manure for the light neighboring soils.

An analysis of two hundred grains of this clay gave the following results:

Carb. lime,	66.00 grs.
Alumine,	120.00
Silex,	14.00
	200.00

This bed of clay has been found to be twelve feet thick at a well on the west side of Pine lake, and to repose on fine sand.

Clay was again noticed on section thirteen, township four north, range two west and two east, in the banks of the Cedar river. This clay contains only a small portion of lime,

is free from gravel, and will afford a tolerable material for brick.

Blue clay, containing gravel and pebbles, occurs at intervals along the banks of Grand and Cedar rivers.

Clay suitable for brick was observed in the town of Leslie, near the village of Leslie. In the town of Stockbridge, on section eleven, clay that will afford a good material for brick was also noticed.

Building and Flagging Stone

The great sand rock formation embraces the only rock found in place in Ingham, and the north and east parts of Eaton counties. It is exposed at many points along the Grand and Cedar rivers, forming in some cases, perpendicular cliffs. It is also seen at a distance from the river, in the beds and banks of the small streams. At many points in the county the rock is found covered by only a slight depth of soil, and it may reasonably be supposed that as the settlement of the county advances, the rock will be found to approach sufficiently near the surface for quarrying, at many points where it is now wholly unperceived.

Southwest from the mouth of the Cedar river, on section nineteen, a compact, grey, calcareous sandstone occurs in the bed and banks of Grand river. An analysis of this sandstone showed it to be composed of

Siliceous sand with mica,	60.00 grs.
Calcareous matter,	40.00
	100.00

Embraced in this micaceous sandstone is a compact, white, quartzose sandstone, cemented with lime. Both these varieties of sandstone will afford a valuable material for building. The upper portion of the calcareous sandstone is composed of thin layers, which would answer a valuable purpose as a flagging stone.

In the southwest part of township three north, range two west, a sandstone well adapted for building purposes, was noticed in the bed and bank of Grand river. It is regularly stratified, the layers being from two inches to twelve inches in thickness. It may be quarried in blocks of several feet superficial extent. It contains numerous remains of extinct plants. This rock is analogous to the calcareous sandstone near the mouth of Cedar river.

In the town of Onondaga, Ingham county, on sections seven, twenty-eight and twenty-nine, a coarse, quartzose, micaceous sandstone was examined, some portions of which will afford a good building material.

On section thirty-six, township four north, range two east, in the bed and banks of the Cedar river, a white, coarse grained micaceous sandstone occurs. It is friable when first taken from the quarry, but hardens upon exposure to the atmosphere.

This out-cropping edge of sandstone embraces a bed of bituminous shale and coal.

An out-crop of the sandstone was examined in the bank of Deer creek, near the surveyed line of the canal, on section fourteen, township three north, range one east, Ingham county. This sandstone resembles, in appearance, the calcareous sandstone at the mouth of the Cedar river, is very much shattered, and some of the blocks have nearly a vertical position.

Sandstone was again noticed on section twenty-two, town of Leslie, and is apparently well adapted to economical uses. It resembles in texture the sandstone at Napoleon.

Sandstone of a friable nature was noticed on sections sixteen, twenty and twenty-one, in the town of Vevay, from one to two miles south of Mason. The quality of the stone cannot be well known until excavations are made.

Sandstone also occurs on Grand river, Grindstone and Coal creeks, in Eaton county, in mural walls of from ten to forty feet in height, and extends along each of these creeks for the distance of a mile, and along Grand river for a distance of

from one and a half to two miles. These sandstones embrace a succession of coal, fissile shale and iron ore. They also contain many remains of plants.

Some portions of the sandstone will afford a good material for building, as also for grindstones.

On section twelve, in the same township, forming the bed of Grand river and occasioning a strong rapid, is a fine grained sandstone cemented with lime, and characterized by the appearance of numerous vegetable impressions.

A good material for building and grindstones, and embracing a bed of bituminous shale, was noticed in the bed and banks of Grand river, on section twelve, town one north, range three west, Eaton county, and section seven, town one north, range two west, Ingham county. It extends north along the valley of the Grand river into the adjoining township. It is here overlayed by a thin bed of coarse red sandstone that has an irregular dip of about four inches to the foot.

Coal

The whole rock formation of Ingham and Eaton counties may be referred to the coal bearing series, and several beds of this material, which may be looked upon as valuable, have been examined. The level and unbroken character of the country which brings the rocks but rarely to the surface, together with the disintegrating nature of the rock, (the latter serving to cover those edges, which under other circumstances, would be exposed,) render it difficult to follow these beds in a continuous manner, but no doubt can be entertained but they exist over a large area of the counties.

The most extensive beds of coal were noticed in township four north, range one and two east, in Ingham county, and ranges three and four west, in Eaton county.

Coal also occurs in the valley of Coal and Grindstone creeks, and on section three, ten and eleven, on Coal creek. The coal is here comprised in four beds, having a thickness of four, ten,

twelve and twenty inches, and neither bed exceeds two feet at any one point.

It was examined at several places along the table lands, and in the bed of the stream, for a distance of one and a half miles, where in consequence of its dip, I was unable to trace it further.

The coal is embraced in a succession of fissile shales, and compact and friable sandstone, varying in thickness, from five to forty feet. I was enabled to remove several bushels from the different localities, that proved to be highly bituminous, and of very good quality, though occasional pieces were observed slightly contaminated with iron pyrites. It ignites easily, burns with a light flame, and leaves only a small quantity of earthy residuum.

The coal on Grindstone creek is a continuation of the coal on Coal Creek, and was traced in the immediate vicinity of Grindstone creek, across the eastern parts of section three, ten and eleven, where a part of the coal had but a thin covering of soil, making a distance along the stream of one and a half or two miles. The coal here consists of a single bed, having an average thickness of eighteen inches, and at no one point, exceeding two feet. Other beds of small extent, were noticed along the same stream.

In the north bank of Grand river, in township before mentioned, a thin bed of coal occurs, having an average thickness of three inches and not exceeding six inches at any one point. This coal, which is also embraced in a succession of fissile shale, compact and friable sandstone, varying from ten to thirty-five feet in thickness, was traced across section two, three, ten, eleven and twelve, where in consequence of its being covered with debris, I was unable to trace it farther.

A bed of bituminous coal more than two feet thick, of a superior quality, in town four north, range two east, occurs in the bed and bank of Cedar river, Ingham county. It was traced along the stream, for nearly half a mile, where, in consequence of its dipping below the stream, I was unable to trace it further. This coal is overlayed by a broken down sandstone and fissile shale, varying in thickness, from five to ten feet. In consequence of its appearance in the bed of the stream, and the friable condition of the sandstone, I was enabled to remove several bushels of coal, which proved to be bituminous and of an excellent quality, containing but very slight traces of iron pyrites. It is compact, has a glossy lustre, ignites easily, burns with a light flame, and leaves only a small quantity of earthy residue.

I was informed by Mr. Haden, that in excavating to repair Mr. Ingersol's mill, on the north bank of Grand river, in township four north, range three west, coal was penetrated upwards of a foot. The coal has a covering of coarse sand and pebbles, twelve feet thick. Some of the coal was examined, which proved not inferior to that on Grindstone creek, Eaton county.

I may here be allowed to express my obligations to many gentlemen, for the information which they have rendered, and hospitality which has been extended to me.

COLUMBUS C. DOUGLASS,
Assistant Geologist.

Detroit, January 28, 1839.

[No. 5.]

Report of Bela Hubbard, Assistant Geologist

To Douglass Houghton, State Geologist.

Sir—in compliance with your instructions, entrusting to me the geological supervision of the counties of Wayne and Monroe, I completed, late in the season, a detailed examination of those districts, the most prominent results of which are now submitted. It is hardly necessary to add, that as the annual reports are designed to embrace only subjects of

immediate utility, considerations of a theoretical nature have been avoided.

Collections as extensive as was practicable, and which illustrate the subjects treated in the report, are deposited in the cabinets attached to this department.

In the furtherance of your plans, much attention has also been bestowed towards a correction of the minute topography of the country; a task rendered peculiarly difficult in the older counties, on account of the imperfections of the original surveys. It is however believed, that sufficient accuracy and completeness have been attained to furnish greatly improved maps of this section of our state.

WAYNE COUNTY

Topographical Features

Nearly the whole of Wayne county is included within that portion of the peninsula, constituting its eastern border, in which no considerable prominences occur, and the descent to the coast is gradual and uniform. In this county, consequently, if we except the township in its northwest corner, the general level is varied only by gentle undulations or isolated sand ridges, forming no continuous ranges, and seldom exceeding the relative height of 20 feet.

The greatest elevation of coast from Milk river point on the St. Clair, down to the Rouge, is about 20 feet; from the Rouge to the mouth of the straits, 10 feet.

Along the whole eastern border of the county, the altitude attained at distance of six miles from the coast, varies but little from 33 to 36 feet. At a single point only, in the vicinity of Detroit, it attains to 45 feet above the river; the general level of the table land at this place being about 26 feet.

A portion of this belt, three miles in width, extending through towns of Hamtramck, Greenfield and Springwells, falls from the general level and is proportionately wet. Below the Rouge this belt becomes intersected by wet prairies, extending over the west half of Ecorce to the Huron river.

Throughout that portion of the county comprised in the belt above mentioned, the streams flow with but moderate current, have generally deep channels, and frequently spread into broad marshes near their embouchure, and even in high stages of the water, to the distance of several miles inland. These borders of marsh alluvion are frequently many acres in extent; as at Grand Marais of Lake St. Claire; on the Rouge, Ecorce, Brownstown and Huron rivers.

Beyond the belt above described the land rises more rapidly, attaining at the western line of the county to about 140 feet above the straits. The streams are rapid and furnish abundant water power.

Two-thirds of the county are flat, heavily timbered lands, producing a stout growth of oak, elm, white wood, maple, beech, lynn, (bass,) ash, hickory, butternut, black walnut, &c. Chesnut is found on sandy ridges in the towns of Dearborn and Van Buren. The remaining third is undulating oak openings, or plains interspersed with wet, grassy prairies; the latter obtaining a proportion of about one-fifth. The proportion of actual swamp is small, and probably little or none exists that may not be reclaimed by a course of drainage properly conducted.

Soil, and Agricultural Character

Clay and sand loams constitute the soils of the timbered land. These occupy nearly equal proportions of surface and often alternate within short distances. The former derives its character from a bed of yellow or brown friable clay, which reposes upon the extensive blue clay deposite immediately overlying the limerock.

Clay is reached throughout the portions characterized by sandy soil, at a depth of from 5 to 12 feet.

The upper clay has an average thickness of 5 feet. The lower clay is of a variegated blue color, gravelly, and inter-

sected by layers of strata of quicksand and gravel. This clay sometimes approaches the surface, as in the vicinity of Detroit. Its average thickness must exceed 100 feet.

These soils are excellently adapted to agriculture. Silex enters largely into their composition. Both clays generally contain a large portion of lime,[34] which adds to their fertility. The contained gravel assists to conduct away the surface waters and prepare the ground for tillage, while the retentive powers of the clay render it little liable to suffer from drought. Thus, while the sand loams may be cultivated to wheat and other grains, the greater portion of the clay lands is natural meadow, adapted to grazing. Its value for this purpose is beginning to be understood, and it is probable that were its merits fairly tested by a system of dairy farming, it would prove productive of a profit to the husbandman second to none in the state.

The sandy oak openings and plains are generally productive. They possess the advantage of being easily tilled, and are well adapted to grain and root crops. Some portions produce good wheat. This soil contains only a minute proportion of lime.

No part of the county can be said strictly to have a limestone soil. The great limerock formation approaches the surface at several points in Brownstown and Monguagon, but is in general too deeply covered by the clays to allow it to characterize a large extent of soil.

In the town of Plymouth, a different character of country prevails from any yet described. This town and part of the two adjoining, may be considered as lying without the border portion of the peninsula, in which I have described Wayne county as included.

This township presents a surface more rolling, and broken into frequent ridges. They rise often from 60 to 80 feet from

[34] An analysis of 100 grains of the clays, taken at random, showed

	Upper Brown Clay	*Lower Blue Clay*
Sand and siliceous matter	51.50	27.50
Alumine	29.95	52.30
Carb. lime	18.55	18.98
Oxide iron	.00	1.22

the plain, with a steep declivity, and having no apparent uniform direction. They are composed of gravel associated at the surface with a clay loam. For the production of wheat, probably this soil is not excelled.

The boundary between the land of this character and the more level tract which constitutes the whole remainder of the county, is strongly marked by a low gravelly ridge, the supposed former shore of the lake. Its course is southwest through a corner of the town of Livonia, entering Plymouth between sections 12 and 13, passing a little to the east of Plymouth corners; thence through section 33 into the town of Canton, which it leaves on section 30. As but a small portion of this ridge is found in Wayne county, a particular description is deferred to a future report.

Boulders

No part of the county can be denominated stony. Imbedded in the clays, and occasionally found grouped upon the surface, are water-worn boulders or fragments of the primary rocks. A species of reddish granite predominates, occurring frequently of more than a ton weight. Boulders are found in great numbers in the town of Plymouth, a large proportion being of fossiliferous limerock. Limestone boulders are also numerous in the bed of the Huron river, sometimes of large size. Occasional banks of *cobble stones* were found heaped along its sides, of a size suitable for paving.

An interesting locality of boulder rocks was met with at Rawson's mills, town of Van Buren. An excavation in the river bank had exposed a bed of limestone and clay-slate rocks, thickly deposited near the water's edge, to the depth of several feet. The slates were often of two or three feet in diameter, of dark color, fissile, and containing iron pyrites.

Marshes or Wet Prairies

Comprise extensive tracts; they are of generally similar character, being low portions of the sandy openings that have been subjected to an overflow of water for a sufficient period to allow a deposition of muck or *peat* from vegetable decomposition. This peat supports a growth of wild grass, destined to add annually to its accumulation. Thus what were ponds, become by this process extensive beds of vegetable soil, varying in humidity with the seasons. These beds have a depth of from one to six feet, and upwards.

Indications are apparent which prove that very many, at least, of these peat marshes had their origin in the labors of the beaver, aided by the natural conformation of the surface. They occupy gently rolling tracts, in which ridges of sandy "openings" and detached prominences or *islands* of the same are intersected by long bands of marsh. Nearly all the streams of the border townships head in these tracts, and it is easy to conceive how the portions now converted into marsh might have been flooded by the obstruction of those natural channels.

If this view be correct, the practicability of drainage becomes at once established, and such conclusion is verified by actual results.

The following comprise the principal marshes of the county:

About fourteen sections, two-thirds of which are in the town of Hamtramck, and the remaining third in Oakland county, are of the character above described; but not more than one-half this extent is actual prairie. This yields an abundant growth of wild hay. The marsh is now in the progress of successful drainage. A thickness of fibrous peat is disclosed, averaging four feet, succeeded by a subsoil of gray sand, nearly free from aluminous and vegetable matter.

Prairie of similar character occurs in the towns of Greenfield, Redford and Royal Oak. It covers 8 sections, one-half of which is in Oakland county. Comparatively a small portion consists of dry openings, and one-half bears a dense

growth of small tamarack. Its soil varies in depth from three to six feet, and is in many places so charged with water as to be tremulous. It produces large quantities of cranberries.

Prairies of a different character occur in the lower part of the county, over a surface of 46 sections, of which 18 are in the town of Ecorce, 11 in Brownstown, 7 in Romulus and 10 in Huron.

Branches of the Ecorce and Brownstown creeks meander this tract. These, flowing with little descent through lines of level prairie, are ramified in every direction, and form a net work or connected chain of marshes over the whole surface. The dry portions consist of sandy plains, frequently but little elevated above the surrounding marshes, and producing a scattered growth of yellow and white oaks. They sometimes assume the form of ridges, which continue unbroken for many rods, and without any uniform direction. The marshy portions, which generally predominate, have a soil of black muck, intermixed with sand washed from the adjoining plains, averaging 2 to 3 feet in depth. This is covered by a few inches of light, fibrous peat. Subsoil is sand. In a few instances clay was found approaching the surface, and it undoubtedly underlies at no great depth.

Wild hay is cut on these marshes in considerable quantities.

According to reports of Indians, beavers disappeared from this region thirty years ago. Their numbers previous are said to have been incredible.

Few trials have been made in drainage. A shallow ditch, or even a passage cut through a beaver dam, has in two or three instances effected great improvement. I observed vegetables growing upon a piece thus ditched, and it is said that wheat succeeds well.

This tract is owned mostly by "non-residents." Several untenanted houses gave evidence that a few families who had commenced a settlement have deserted to more favorite spots. Ditching had not been attempted. The expense of this kind

of improvement is comparatively small, and I do not doubt that were less than half the ordinary labor in "clearings" bestowed upon a course of drainage, these lands, instead of their present little estimation, might soon be accounted amongst the most fertile in the state.[35]

In the southeast quarter of range eight east, town of Huron, marshes occupy, it is supposed, two-thirds of the surface. They have a peat soil, averaging two feet, but occasionally much deeper and inclined to bog. Cranberries grow abundantly. Branches of Swan creek meander this tract in such manner as to facilitate drainage; and the comparatively dry character of a large portion will render the cost of ditching moderate.

Smaller marshes occur in the county, though not frequent, and of little general account.

Encroachments of the River and Lakes

Extensive damage has been occasioned by the unusual height of the lake waters during several past seasons. From the St. Clair to the Huron river, the coast, which is mostly gravelly blue clay, with alternations of sand, has been abraded to such an extent, since 1835, as to remove the entire line of coast, where unprotected, several yards to the westward. Along the coast of Hamtramck, above Detroit, scarcely a vestige of the old river road remains. Near Milk river point the waters are said to have advanced inland 150 feet within the past two years. Below Detroit the depredations upon the coast have been less severe, but sufficiently so to render a portion of the road below the Ecorce unserviceable, and deprive the already narrow turnpike above of several yards of its width. Along the Gibralter front, at the mouth of the straits, where the bank is from 6 to 10 feet in height, the waters have advanced 10 feet inland

[35]Ditches may usually be cut, of 3 feet wide by 2 feet deep, for from two to four shillings per rod; perhaps less. The main ditches of the extensive marshes in Hamtramck, owned by Judge Conant and others, are 6 feet by 4, and cost $1 per rod.

This abrasion of the coast has been in progress not only for the past two or three seasons, but to some extent through the fluctuations of level in the lakes during a much greater term of years. While the configuration of the straits preserves the Canada shore in a great degree from erosion by the current, its whole force is felt upon the western coast; a much greater abrasion being prevented only by the low and shelving character of a large portion.

From the same cause the marshes bordering the shores have been greatly extended. Many acres of former arable land, both in Wayne and Monroe, are now embraced by the waters. Numbers of orchards, the growth of a century, have become a prey to the flood, and families of the old French inhabitants are driven from homes till now occupied from childhood. The United States road from Detroit to Monroe has been rendered impassable at no less than three points, and the travel forced into other and circuitous routes.

Leaving to an abler pen the investigation of the causes of this unprecedented rise, it may not be amiss to notice, briefly, such remedies as have been tried, or may be proposed to check the devastations occasioned by it. Should those causes continue to operate in maintaining the present elevation of the waters, the subject will become of vast importance to the interests of this portion of our state. Every foot of coast now suffered to waste away, involves a loss much exceeding that already sustained. The inconvenience now felt from the diminished breadth of the river road below Detroit, calls for one of two remedies; either the roadside must be protected by a dock along nearly its whole extent, or a new and broader road must be opened in the rear and beyond such a probable future contingency. The former method, owing to its expense, will, it is presumed, never be resorted to by public authority, nor by individuals to much extent.

Although the erection of docks is undoubtedly the only permanent protection, more simple remedies may to some extent prove of avail. Quantities of brush, strewed thickly

along the exposed bank, afford a considerable protection against the direct force of the waves, and also aid, by the retention of the sand and gravel brought up, to form a beach along its foot. A heavy log or fallen tree, placed at right angles to the shore, serves to accumulate a beach, and thus often affords protection.

These remedies are not invariably successful; but they are easily attainable, involve but small expense, and will be properly estimated if they tend to preserve even a small portion of the wealth of the landholder from the devouring wave.

Clay

Clay suitable for bricks and pottery, is found at numerous places in the county, though the value of much of it is deteriorated by the presence of lime. The manufacture of bricks is conducted at several points.

At Springwells a brick yard has been established for several years. The clay used is from the blue clay deposite, and is tolerably free from grit. The sand is taken from a cap or hill lying above the clay, with strata of gravel interposed. The bricks find a market at Detroit. About 500,000 are manufactured annually, worth $5.00 per thousand.

A superior clay for brick is found in the banks of the valley of the Rouge, and several kilns are established in the towns of Springwells and Ecorce. At a yard belonging to Mr. Abial Wood, on the south side of the river, (farm No. 661,) the clay employed is of a light blue color, free from grit. It improves with the excavation. At a depth of six feet, I observed it of a lighter color, sometimes veined with white. About 300,000 bricks were manufactured this season.

At the yard of Mr. Wood, on the opposite side, about the same number have been made. This yard has been established three years. The blue clay is used, and is said not to improve with depth. The overlying yellow clay is considered inferior. A cap of sand overlies, of 2 to 4 feet.

Two adjoining brick yards have manufactured about the same number each;—an amount this season less than usual, on account of the prevailing sickness.

A fine blue clay appears near the river bank at Flat Rock, from which brick is made. Its quality is said to be impaired by lime. About 500,000 have been burned.

At Morris, three miles above Mt. Pleasant, a brick yard is commenced—clay said to be of good quality. The yard is on the summit land adjoining the river, at a height of 50 feet.

Two yards are established on the middle branch of the Rouge, in the town of Nankin. At Wilkinson's near Schwarzburg, clay appears in a stratum running along the bank, and is here two and a half feet thick. Portions contain too much lime to be used with advantage. Good bricks are manufactured of the clay taken from the river bottoms, at Swift's, section 11.

A bed of clay occurs in the town of Plymouth, section four, from which bricks and earthern ware are manufactured. It consists of strata of the blue and yellow varieties underlying probably 8 acres, with an average thickness of 4 feet. A cap of sand, of 2 feet thickness, overlying, is used in the manufacture. Sand and gravel underlie the bed of clay, which are unfit for use from the lime contained. The bricks are of good quality; 100,000 were made this season, worth $5.00 per thousand. The pottery ware receives a good glaze, and is durable.

A bed of clay exists west of Plymouth corners, section 27. It is supposed to cover 80 acres. Considerable lime is contained; 500,000 bricks are made from it each season.

A bed of fine blue clay exists on section 11. The above were the only deposites observed in this township.

Blue clay appears at the surface in the town of Canton, which is free from lime.

In the town of Huron a fine blue clay underlies the low lands bordering Swan creek, at small depth, and frequently comes to the surface.

The blue and yellow clays make their appearance at every bluff along the Huron. They are in general very marly and seldom free from grit. A kiln was erected in a ravine of Woods' creek, section 36, Van Buren, but the clay proved so calcareous that the works were abandoned.

Limerock

The great limerock formation, upon which the clay deposites of the county rest, makes an *out-crop*, or appearance at the surface, through the townships of Monguagon and Brownstown. It forms the bed of the strait near its mouth, as well as a foundation to the islands.

The most easterly point at which the rock appears above the level of the water, is at Stony island. This is wholly constituted of the rock, covered by only a few inches of soil. Limerock was formerly quarried upon this island, as is testified by numerous pits, but the fractured surface stone only appears to have been removed. These fragmentary rocks seldom exceed a foot diameter, are of a white color, compact, and afford good lime. The island is but little above high water level, and the pits are now flooded.

Quarries have been opened at the lower end of Grosse Isle. The rock makes its appearance in a slightly elevated ridge, at some distance from the shore. Trenches are opened for quarrying in no place more than 5 feet deep. The upper layers are of a few inches thickness, removable in irregular pieces of a size suitable for rough building. One of the trenches exposes a stratum of 3 feet thickness, for the distance of 300 feet. This stratum is compact and may be broken out in nearly square masses.

Sulphate of strontian, in large chrystals, is abundant in the upper layers. No fossils were discovered.

In section seven, of Monguagon, is a protrusion of the rock in a ridge, occupying a surface of a dozen acres. Quarries have been extensively worked, chiefly for lime. The rock is in a strata of from 6 to 10 inches thickness, of gray color, chrystalline, and eminently fossiliferous. The quarries have extended to the depth of 6 feet. The color of the stone deepens into blue, and its hardness increases with the depth. Calcareous spar is contained in chrystals, lining small *geodes* and fissures. Thin layers of indurated bituminous matter, approaching coal, are contained between some of the strata. The largest masses of stone observed to be quarried in good condition, were two feet in length by about eighteen inches wide. Whether larger slabs might not be obtained by proper care, I was unable to learn. It is fully equal in beauty to the much admired building material brought from Ohio, but its superior hardness renders the dressing and polish much more expensive.

From 9,000 to 12,000 bushels of lime are manufactured annually at this quarry.

Limerock makes its appearance in Brownstown creek, one and a half miles west from Gibralter, and has been used to a very limited extent for domestic purposes.

Rock is said to appear at the water's edge on the lower end of Celeron island.

Limerock forms the rapids in the Huron at Flat Rock. It appears in a smooth almost unbroken bed, for the distance of forty rods, forming a foundation to the dam above, and disappearing in deep water below the mills. The rock is of a dark gray color, occasionally porous. A specimen contained hornstone.

Rock was also occasionally found forming the bed of the channel from Flat Rock till within two miles of Mt. Pleasant, and large tabular masses, but little worn, appeared even farther up, proving the existence of rock in place at no great distance.

A very slight general *dip* in the limerock of this county, northwesterly, is observable.

Marl

The only deposites of shell marl known to exist in this county in sufficient quantity for economical purposes, are in the town of Plymouth. The following deserve notice:

On section 22, (at Deacon Purdy's,) is a small deposite, which occupies two-thirds of an acre. As other beds occur in the township of similar origin, it may be advisable to notice the circumstances of its formation. Upon a gentle slope a protuberant bog has formed, which is wet and slightly tremulous. It consists of peat, or vegetable matter, having a depth of about 3 feet. Below this is found the marl, which has here a thickness of from one to three feet. It is a plastic substance of a milky gray color, perforated by roots and may be cut out in masses like clay. The presence of lime is indicated at the surface by a calcareous deposite upon moss.

Beds thus formed originate chiefly in deposition from water of springs highly charged with lime; circumstances under which *tufa,* or indurated deposites of lime, usually occur. Lime is favorable to the formation of shells, which are generally associated in abundance, but do not constitute the bed as when it occupies the former bottom of a lake. Several species of the genius Helix (snails) are most numerous, with Lymnea, Planorbis, &c.

As the producing causes are still in operation, marl existing under these circumstances may be supposed still in progress of formation.

Eight hundred bushels of lime have been manufactured at this bed. Much of it beautifully white and of good quality.

The marl furnishing this number of bushels was taken from an area of three square rods. Should the deposite cover but half an acre, with the depth of a foot, (a low estimate,) the amount of lime it is capable of furnishing would be 21,333 bushels. Five hundred bushels of this lime cost in the digging and manufacture 57 days' labor. Reckoning these as so many dollars, and the lime at two shillings per bushel, (average price,) there will appear a profit of more than one-half the price brought by the article.

On the farm of Caleb Herrington, Esq. sections 5 and 8, a very extensive deposite was exposed in digging a drain to remove the water from a tamarac swamp. At several places a pole was thrust into the bed, without passing through, to the depth of six feet. From the indications apparent, I am led to believe that the entire area of the swamp (30 acres) is underlayed by the marl. It is compact, heavy and plastic. This marl is well adapted to the manufacture of lime, but has not yet been applied to that purpose.

On the land of Sylvanus Taft, section 4, is a bed of an acre or more in extent, with an average thickness of two feet. It is compact and of good quality. No lime has been manufactured, but much of it used in its natural state, by the neighbors, for plastering and whitewashing, is said to have fully answered the purposes of kilnburnt lime.

Numerous other indications of marl occur through the township. A bed is said to exist on section 27. Also on farms of Mr. Holmes and others, probably to small extent.

A small bed was found on land of Wm. Yerkus, section 2.

Upon the surface of a knoll at Waterford a considerable quantity of a dry pulverized marl was observed.

On the farm of Pitz Taft, on the base line, within the boundary of Oakland county, is a deposite which may be noticed in this connection. It covers two acres, with an average depth of six feet. It is a tufaceous shell marl, in coarse particles, with a stratum of tufa underlying, and occurs under circumstances similar to those of the deposite on section 22, first noticed.

Ten square rods have been excavated, out of which were manufactured, 3,000 bushels of lime of good quality. It sells at three shillings per bushel.

Assuming the above proportion, the quantity of marl may be estimated at 31,680 cubic feet. The amount of lime which the bed is capable of furnishing, at 96,000 bushels.

Marl, in small quantity, has also been found in town of Canton, section 9.

No experiments have been made in the employment of marl as a *manure*, in this county, nor, so far as I am informed, elsewhere in the state. This is somewhat a matter of surprise, since trials of plaster (gypsum) and quicklime are acknowledged to have produced extraordinary results. It is, however, scarcely known to our farmers that marl, or *bog lime*, may be used with equal profit, while it has the advantage of being obtained at a much cheaper rate. It deserves to be made the subject of immediate and ample experiment, particularly upon sandy soils, and those which are found to contain but small proportion of that essential ingredient, *lime*. This is often the case with the lands in the immediate vicinity of the marl beds.

Peat

Peat, or vegetable alluvion, is found in considerable bodies in town of Plymouth, overlying the marl, and in the marshes or wet prairies of Greenfield, Hamtramck, Ecorce, Brownstown and Huron. These latter deposites have been already noticed under the head of Marshes.

The greater proportion of peat found in this county belongs to the variety called *fibrous*, being a mere mass of spongy fibres of grass roots, partially decomposed and elastic to the tread. A small proportion is of the *sphagnous*, or peat moss variety. Comparatively little is *compact*, or in a state which would render it of much value for fuel.

A bed in the tamarac swamp on sections 5 and 8, Plymouth, to the depth of five feet, was found to consist chiefly of the kind denominated *ligneous*. It disclosed a half decomposed mass of tamarac logs, with moss, roots, &c. At depth of several feet, I found entire stumps, trunks and limbs of a former growth of timber, retaining their form, but so soft as to yield readily to the spade.

The body of fibrous peat which composes the marshes in Hamtramck, includes about 1,900 acres, with an average depth of four feet.

The adjoining marsh, in Greenfield and Royal Oak, comprises about 3,000 acres of this deposite, with the same average depth. Probably a portion of this peat is of ligneous origin.

From 3,000 to 4,000 acres of fibrous peat, with average depth of two feet, are contained in the marshes of West Huron.

Of the other smaller deposites of peat noticed under marshes, no estimate could be made.

None of these beds of peat have yet been esteemed of importance as an article either of fuel or manure. The wants of our population do not demand any present consideration of its value for the former purpose. But in the latter capacity, it will be found serviceable and cheap, and it is desirable that fair trials of it be made. It may not prove sufficiently decomposed for the purpose until mixed in the compost heaps and consolidated by the application of quick lime. This disposition of it might be made with peculiar facility where it occurs, as in Plymouth, imposed upon beds of marl.

Bog Iron

Deposites of bog ore occur in limited quantities at numerous places; their origin being apparent in the presence of highly ferruginous soils.

In the township of Greenfield, deposites of ore occupy a considerable extent, chiefly on sections four and nine, where I traced it at intervals over an area of one-half a square mile. It follows mainly the course of two brooks discharging into a large tamarac marsh, on section ten, and embraces the intervening ash swales. It is distributed over this area in beds of a few yards wide and irregular patches. The deposite consists of an exceedingly compact bed of a foot thickness, which is broken out in large masses, and it is mostly of inferior quality, being what is technically known as an *old ore*.

This is succeeded by from two to six inches of the variety called shot ore, which is apparently rich. The covering of soil is from a few inches to two feet in thickness. This is by far the largest deposite in the county. Time would not permit a very accurate analysis of the ores of this county, but a more detailed account of their composition may be expected, at a future period, in treating of the other ores of the state. One hundred grains, however, subjected to a rough analysis, gave,

Siliceous and aluminous matter	26.50
Per-oxid of iron,	73.50
	100.00

In township of Livonia, section twenty-eight, bog iron occurs in a low, wet swale, which serves as the outlet to a series of small marshes. The bed follows the lowest portion of the swale for about half a mile, with a width varying from two to four rods, and a thickness of six to eighteen inches. It consists mainly of a bright colored *shot ore*. Peaty muck overlies, of two feet average depth.

Estimating the average thickness of the deposite at one foot, and its width at three rods, will show a proximate result of 130,000 square feet of the ore. From the position of the low grounds following the course of the outlet, it is not improbable that other deposites of this mineral may be found below. The ore is a very rich one, and is well deserving a more extended investigation by the proprietor.

In township of West Huron, section twenty, is a small deposite, occupying an area of thirty rods long, by one wide. It forms a compact body six to ten inches in thickness, mostly "dead ore."

On section twenty-one, a narrow deposite of bog ore occupies the bed of a small run connecting the marshes. It is similar to the above, and of small extent.

Other indications of ore occur in this township; probably of but little account.

Much of the soil of the township of Plymouth is found charged with iron.

Strong indications also exist in the towns of Canton and Nankin, among the wet prairies of Ecorce and along the bottoms of the Huron, in the township of Van Buren.

Chalybeate Springs

occur in several of the above townships.

One in Canton, section 5, has formed a considerable mound by deposite of calcareous matter from the water.

A spring, much impregnated with iron, issues from the river bank, near Rawson's mills, town of Van Buren.

Sulphur Springs

of considerable strength, occur, but are not numerous.

A very large one rises in the bottom of the Huron, in the Wyandot reserve. It occupies a hollow of an oblong shape, 300 feet by 150. The water deposites thin films of sulphur.

In the town of Ecorce, section 22, is a spring very strongly impregnated. It occupies a basin of 100 feet diameter. This spring, with the one above mentioned, probably exceeds in strength any others in the state. They are favorite resorts for domestic cattle, as well as for deer and pigeons.

On section 20, town of Dearborn, several sulphur springs issue copiously from the bank of the Rouge. Their waters also contain iron, which imparts an inky color to surrounding surfaces, by combination with the characteristic acid of their vegetable portions.

A spring of considerable strength issues from the bank of the Huron a mile below Flat Rock.

On section 29, Brownstown, a spring, strongly impregnated, rises in the edge of a tamarac marsh, forming a large basin. The stream issuing is sufficiently large to overspread a considerable tract. Indications of salt and lime were present.

Strong sulphur springs abound in the neighborhood of the marshes around Gibraltar. Their vicinity is strongly colored by a milkwhite precipitate.

The source of these springs is noticed under the geology of Monroe county.

Brine Springs

Springs of brackish water are found occasionally through the northern and western townships; but their position in regard to the true saline district of the state, would probably not warrant the expectation of profit resulting from them in the manufacture of salt.

Several "licks" were visited in the towns of Springwells, Redford, Canton and Nankin; but they contain, mostly, the salts of lime.

A spring, impregnated with saline matter, rises on the bank of the Rouge, in town of Redford, section 27. The discharge from it is about 60 gallons per hour.

In an early state of the country, salt was manufactured here by the Indian and French settlers. A hollow gum was sunk, which has long since rotted away. Furnaces were constructed of brick. An attempt was made a few years ago, at considerable expense, to revive the manufacture. The result was the manufacture of a small amount, half a bushel of which was sold in Detroit as table salt. Sickness occasioned discontinuance of operations, which the diminished price of salt has since rendered unprofitable.

In the town of Nankin, section 11, springs occur, at one of which a well is now sinking preparatory to an attempt at salt manufacture. The excavation has proceeded eight feet, being protected by a strong curb of wood. I was informed by the proprietor that an ordinary pail full of the brine produced a gill of saline residuum.

An analysis of 100 cubic inches of water from this spring, furnished in the first annual report of the State Geologist, showed 38.47 grains of muriate of soda, (common salt,) combined with muriate of lime and other matters. This result exhibits a strength equal to only one-fourth that of the brine springs at Grand Rapids, and less than one-tenth that of the springs of the Tittabawassa, the points at which operations are commenced for the state salt manufacture.

In regard to the conduction of operations by individual enterprise, we would refer to the whole subject of brine springs as presented in that report. It may thus be seen under what conditions only certain reliance can be had of ultimate success; nor should it appear surprising that expectations, not the result of a thorough understanding of the subject, may end in disappointment.

Water, Wells and Springs

The county may be considered as in general, well watered, by streams discharging into the straits at intervals of a few miles. Their waters, like that of the lakes, are *soft*. The River Huron alone forms an exception, which passing over limerock and through marly clays, becomes *hard*, or charged with lime.

The early French settlers dug no wells. They clustered about the streams, and partook from those natural fountains. The surface waters thus in most cases obtained, and from streams often winding sluggishly along low and marshy banks, afforded but an indifferent beverage.

Numerous wells have since been sunk, and with various success. The thick bed of blue clay which underlies the county at small average depth, though charged with gravel, is not sufficiently pervious to admit the percolation of large underground streams. For this reason springs do not abound, and a large portion of the water of wells is a mere drainage from the surface. Some springs, however, exist in the clay district, as on the Bloody run. They are more frequent and copious beneath the caps of sand and through the openings, as at Springwells, (La Belle Fontaine of the French,) Mt. Pleasant, &c. on the Huron.

But, though the obtaining of water from living springs throughout the clay district, is thus in a degree rendered uncertain, excavations for water have been generally successful. Occasionally copious streams are opened, discharged through *seams* of gravel and sand. Usually water percolates slowly through a gravelly stratum of the clay, and is sweet and pure, and in sufficient quantity for ordinary purposes. Well-diggers assert that such a seam of gravel, at depth of twenty feet, is very general.

These experiments determine: first, that a reasonable prospect exists of obtaining good water by digging; secondly, that a very deep excavation cannot be recommended.

Wells of from five to twenty feet, frequently afford an abundant supply, rising from below: while excavations in the same neighborhood of from fifty to one hundred feet, through a hard, dry, reddish blue clay, yield no water or are filled from the surface. The boring at Detroit, which extended to the depth of two hundred and sixty feet, one hundred and thirty-three feet of which was in rock below the clay, failed to furnish the desired supply. Instances have occurred, however, from diggings in the vicinity of the limerock, of a very copious discharge from an unusual depth.

Much of the bad effects of stagnant water might be avoided by occasional cleansing of wells. A fresh supply should be obtained by thoroughly draining the well of its contents, whenever an approach to putrefaction is perceived.

Might not a quantity of lime or charcoal, whose antiseptic qualities are well known, thrown in, be a useful auxiliary in preserving purity?

No purer water perhaps exists than that of our immense upper lakes, the whole body of which passes through the straits of Detroit. It is exceedingly soft, and in its under current of almost uniform coldness throughout the seasons.

Detroit denied herself the enjoyment of this luxury, when, by an unfortunate policy, the supply that should have been sought in that volume which flows pure and icy cold in the

depths of its channel, is transferred to the reservoir from the warm, contaminated surface, at the docks.

A remedy is obtained by removal of the works above the city and the substitution of iron pipes for wood: but it is suggested whether another improvement might not be effected by extending the supply pipe from its present mouth, at five feet below the surface, into the deep recess of the channel.

Plymouth, which borders on the flat clay district, is the only township that abounds in numerous and copious springs of the purest water. Through this tract of broken, gravelly hills, single springs occur sufficient to give rise to considerable streams.

Roads

The importance of good roads to Wayne county, particularly in the flat district bordering on Detroit, has been long felt, and much labor and expense have been bestowed towards their improvement. Nor can the value of a universal highway, passable with safety and expedition at all seasons, scarcely be overestimated. The soil of this heavily timbered region, it is true, is but ill adapted to such roads as are required, but great improvements might be effected in their present management.

The importance of the subject will excuse, in these pages, an allusion, though necessarily brief and imperfect, to improvements of this nature; more especially as such only will be referred to as impose no additional expense, but occasion an actual reduction of present outlays to a vast amount.

Heavy taxes are annually assessed for construction and repair of roads. These frequently fall into the hands of men who are ignorant or careless of essential facts, and are appropriated without the oversight of those who are most interested. Or, a requisition is made upon the districts once or twice a year for personal services, on which occasion the whole amount of tax is expended, and the road passes without attention the remainder of the year.

Instead of this inadequate method, we would advise the appointment of a road overseer of at least some practical science. It should be his constant occupation to smooth the ruts and repair every damage as often as they shall occur. A permanent, uniform service should be preserved. This may be effected by means of a broad road scraper and a few hands, only, employed as an occasion requires. The work will then be more effectually accomplished, and will require less than one-half the time, labor and cost ordinarily expended.

In road construction it should be borne in mind, that a liberal breadth is favorable to the preservation of a uniform surface. It removes the necessity for a constant use of the same track; thus such portions of the road are avoided from choice as are otherwise cut into continually deepening ruts and hollows. No small advantage also results in the increased facilities for evaporation due to a wider exposure to the sun and a more free circulation of air, as well as in the convenience of ample sidewalks for foot passengers.

The necessity for free removal of water from the side ditches, by drains, conducting to lower levels, is also an urgent consideration. While these are essential to the perfect accommodation of the soil to agriculture, it is also evident that if the roads are left to dry solely by the slow and uncertain process of evaporation, no continuance of labor can be completely effectual.

It may be important to consider whether the elevated crowning given to some of our roads, be not useless as well as expensive, for the steep sides and uneven draught thus created, force all the travel into the only safe path, at the top of the grade. The Grand river road, which was thus constructed for a few miles, at great expense, is probably in worse condition at all seasons than if the travel were permitted to shift at will over the same extent of more level surface. A rise of one inch in three feet is thought by the most skilful road engineers more than sufficient for purposes of drainage,

and it is evident that as ruts are longtitudinal to the direction of the road, an increase of elevation cannot assist to conduct off the water which inevitably settles into these convenient receptacles.

The primary expense of the excavation and embankment would provide all the moderate applications needed on a flat road for a great length of time.

The use of brush or logs as a foundation, can be of permanent service only while a constant solid covering of earth is maintained. This cannot be effected but by continual oversight and attention to the considerations above presented.

Possessing, as does the tract of country under consideration, such slender amount of good materials for road construction, it may be well to inquire whether the loads of gravel removed from the river coast and used to fill in the docks, together with the broken stone and pebbles brought as ballast in vessels, might not be employed to public profit, particularly in the streets of Detroit.

These hints touch but very partially the improvements susceptible in our roads. We aim only at directing attention to the subject. Road making has become a science, and to engineers, of whose profession it is more properly a study, we leave its full elucidation.

MONROE COUNTY

Topography

The county of Monroe partakes of the general uniformity of the surface of the eastern border district of the peninsula. This general level is here interrupted by no sudden prominences exceeding 20 feet in height. The rise from the lake is gradual and nearly uniform, attaining at the western line of the county to about 115 feet. The streams descend with a rapid flow, furnishing numerous mill sites.