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PROCEEDINGS

OF THE

Rochester Academy of Science

VOLUME II.

Edited by
P. MAX FOSHAY, *Secretary.*

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SCIENTIFIC PROCEEDINGS.

Papers read 1891—1892, but not printed.

PROCEEDINGS

OF THE

ROCHESTER ACADEMY OF SCIENCE.

VOLUME 2.

OCTOBER 12, 1891.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Thirty-five persons present.

The addition to the Library, during the summer, of 300 volumes and pamphlets was announced.

The Council report recommended :

(1.) The Payment of certain bills.

(2.) The adoption of the following resolutions :

Resolved : That this Society extends to the American Microscopical Society a cordial invitation to hold its annual meeting of 1892 in the city of Rochester, during the month of August, in connection with the American Association for the Advancement of Science and other societies.

Resolved : That the Council shall appoint a special committee, consisting of fellows and members of the Academy who are engaged in microscopical work, to take the necessary measures for the proper entertainment of the American Microscopical Society.

On motion the bills were ordered paid and the resolutions adopted by an unanimous vote.

The Secretary, MR. FRANK C. BAKER, read a paper on

THE CAVES OF YUCATAN.

(*Abstract.*)

The northern portion of Yucatan is very flat and dry and built up entirely of recent limestone deposited on an early fold of the earth's crust. Throughout this whole region there is no surface water, no running streams, and the only source of water supply for the inhabitants is from aguadas or caves. In the western portion there is a range of hills of about a thousand feet elevation, but aside from this the country is very flat. About the Gulf region there are extensive mangrove swamps, but they do not extend for any distance inland. We can descend through this limestone formation in any of the caverns and find species of fossil invertebrates identical with those now found living on the shores of Yucatan.

The first cave visited was nine miles from San Renado, situated in the north-western part of the country. This cave descended to the depth of 180 feet below the surface. There were numerous passages seen branching off in various directions, but only two had been explored and these were not of very great extent. One passage leading in a northerly direction was followed for the length of a quarter of a mile and was found to gradually shelve down to a point, thus preventing further progress.

The second cave was that of Lantun, situated about fifteen miles from Ticul near the Hacienda of Tabi. This cave descended to a depth of 150 feet, and contained some very beautiful stalactitic columns. In one small chamber, about 120 feet below the surface, was found a fountain of clear, cold water contained in a hollow stalagmite. This fountain was always full but never seemed to run over. One interesting feature of this cave was a passage, said to be ten miles in length, which led in a northerly direction and connected a small village with the cave. This was said to have been a place of refuge for the ancient inhabitants when hard pressed by their enemies. The floor of this passage was covered with ripple-marks, as though water had flowed over it at some distant day. No animal life was found in any of these caves excepting a few shells just beneath the opening, which had fallen in or been washed down by the rains.

The paper was illustrated by several blackboard diagrams and was discussed by the President, Dr. Moore, Professor Ward and others.

OCTOBER 26, 1891.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Thirty persons present.

In the absence of the author, the Secretary read the following paper:

THE MOLLUSCA OF MONROE COUNTY, N. Y.

BY JOHN WALTON.

The Mollusca form a large group of the Invertebrata and are universally distributed. Anyone therefore, so disposed, may make a collection in his own neighborhood and at almost any season of the year secure specimens for study in regard to their structure and habits.

Such a pursuit has been my pastime for years and has proved both interesting and instructive. As a result of such pleasant labor I submit the following list of the Mollusca of Monroe County, which embraces, I think, all but a few of the minute species. This list includes 135 species and varieties, representing 30 genera and 14 families. Except where otherwise noted, the illustrations have been drawn from living specimens of my own collecting and thoroughly identified. I have made my selection of subjects for illustration mainly because of the uncertainty among students concerning their identity, and the difficulty of obtaining suitably illustrated literature for this purpose; the many excellent works upon the subjects here under consideration being now out of print. Believing that in supplying this lack efficiently a permanent benefit would be rendered to students of our local fauna, I have taken special pains to make these illustrations typical and reliable. For the same reason I have avoided all unnecessary shading, that the proportions and contour of the shell in each case might be the more apparent.

In preparing this paper I acknowledge my indebtedness to the excellent work of G. W. Binney, "Land and Fresh Water Shells of North America," which I have consulted freely. Nor should I omit to mention De Kay's "Mollusca of New York," with finely colored illustrations; and the timely aid of the series of Monographs now being published by the Academy of Natural Sciences, Philadelphia, under the general title of "A Manual of Conchology," with Professor H. A. Pilsbury as its able editor; to all of which works, when practicable, the student is referred for further information concerning the shells of Monroe County.

Class GASTROPODA.

Family STREPOMATIDÆ.

Pleurocera subulare, Lea. (pl. 1, fig. 1, 2.) *Lake Erie.*
Pleurocera intensum, Lea. (pl. 1, fig. 4.)
" *pallidum*, Lea. (pl. 1, fig. 3.)
" *gemma*, De Kay. (pl. 1, fig. 10.)

Goniobasis virginica, Say. (pl. 1, fig. 11, 12, 13.) *Erie canal.*

Goniobasis virginica, var. multilineata, Say. (pl. 1, fig. 14, 15.) *Erie canal.*

Goniobasis livescens, Mke. (pl. 1, fig. 8, 9.) *Erie canal.*

Goniobasis depygis, Say. (pl. 1, fig. 5, 6.) *Irondequoit bay.*

Goniobasis semicarinata, Say. (pl. 1, fig. 7.) *Irondequoit bay.*
Goniobasis Grosvenori, Lea.

Family RISSOIDÆ.

Bythinia tentaculata, Lin. (pl. 2, fig. 1.) *Erie canal.*

Gillia altilis, Lea. (pl. 2, fig. 2.) *Erie canal.*

Amnicola limosa, Say. (pl. 2, fig. 3.) *Genesee river.*
Paludina limosa, Say.
" *porata*, Ad.

Amnicola porata, Say. (pl. 2, fig. 4.) *Erie canal.*

Amnicola orbiculata, Lea. (pl. 2, fig. 5.)

Amnicola pallida, Hald. (pl. 2, fig. 6.)
Amnicola lustrica, Ad.

Amnicola granum, Say. (pl. 2, fig. 7.)

Pomatiopsis lustrica, Say. (pl. 2, fig. 8.)
Amnicola lustrica, Hald.

Family VALVATIDÆ.

Valvata tricarinata, Say. (pl. 2, fig. 9.) *Charlotte.*
Valvata unicarinata, Say.
" *bicarinata*, Say.

Valvata sincera, Say. (pl. 2, fig. 10.) *Erie canal.*

Family PALUDINIDÆ.

Melantho ponderosa, Say. (pl. 3, fig. 1, 2, 3.) *Erie canal.*
Ampullaria crassa, Desh.
Paludina decisa, Rve.
" *regularis*, Lea.

Melantho decisa, Say. (pl. 3, fig. 4–7.) *Erie canal.*
Melania ovularis, Mke.
Paludina limosa, Val.
" *microstoma*, Kirt.
" *cornea*, Val.
" *neros*, De Kay.
" *subsolida*, Anth.
" *decapita*, Anth.
" *milesii*, Lea.

Melantho decisa var. obesa, Lewis. (pl. 3, fig. 9.) *Erie canal.*

Melantho decisa var. genicula, Con. (pl. 3, fig. 11, 12.) *Erie canal.*

Melantho deciso var. integra, Say. (pl. 3, fig. 13.) *Erie canal.*

Melantho decisa var. heterostropha, Kirt. (pl. 3, fig. 10.) *Erie canal.*

Melantho rufa, Hald. (pl. 3, fig. 8.) *Erie canal.*

Family VITRINIDÆ.

Vitrina limpida, Gld. (pl. 2, fig. 11.) *Pittsford.*
Vitrina pellucida, De Kay.
" *Americana*, Pfr.

Family SELENITIDÆ.

Macrocyclis concava, Say. *Pittsford.*
Helix planorboides, Fer.
" *dissidens*, Desh.

Family ZONITIDÆ.

Zonites fuliginosa, Griff. *Rochester.*
Helix capillacea, Pfr.
Omphalina cuprea, Raf.
Hyalina fuliginosas, Tryon.

Zonites intertexta, Bin. *Pittsford.*
Mesomphix intertexta, Tryon.
Hyalina " Bin.

Zonites inornata, Say. *Pittsford.*
Helix glaphyra, Pfr.
" *inornata*, Bin.
Hyalina " Tryon.

Zonites nitida, Müll.
Helix lucida, Drap.
" *Hydrophila*, Ingalls.
Hyalina nitida, Tryon.

Zonites arborea, Say. *Pittsford.*
Helix ottonis, Pfr.
" *Breweri*, Newc.
Hyalina arborea, Morse.
" *Breweri*, Tryon.

Zonites indentata, Say.
Hyalina subrupicola, Dall.
" *indentata*, Morse.

Zonites multidentata, Bin.
Hyalina multidentata, Morse.
Gastrodonta multidentata, Tryon.

Zonites minuscula, Bin.
Helix minuscula, Bin.
" *minutalis*, Morelet.
" *apex*, Adams.
" *Lavelleana*, D'Orb.
" *Mauriniana*, D'Orb.
Pseudohyalina minuscula, Morse.

Zonites viridula, Mke.
Helix electrina, Gld.
" *pura*, Alder.
" *janus*, Adems.
Zonites radiatulus, Rve.
" *striatula*, M. Tand.
Hyalina electrina, Morse.
" " Tryon.
" *viridula*, Bin.

Zonites chersina, Say. *Pittsford.*
Helix egena, Say.
" *fulva*, Drap.
Conulus chersinus, Morse.
" *chersina*, Tryon.
Hyalina fulva, Bin.
" *chersina*, Gld. and Bin.

Zonites suppressa, Say. *Pittsford.*

Family HELICIDÆ.

Mesodon albolabris, Say. *Rochester.*
Helix rufa, De Kay. (immature sp.)
Mesodon albolabris var. dentata. *Pittsford.*
Mesodon thyroides, Say. *Rochester.*
Anchistoma thyroides, H. and A. Ad.
Helix bucculenta, Gld.
" *thyroides,* Pfr.
Mesodon bucculenta, Tryon.
Mesodon Sayii, Bin. *Pittsford.*
Helix diodonta, Say.
" *Sayii,* Bin.
Ulostoma Sayii, Tryon.
***Tachea hortensis,** Müll. *East Rochester.*
Helix subglobosa, Bin.
" " De Kay.
Triodopsis palliata, Say. *Pittsford.*
Helix denotata, Fer.
" *notata,* Desh.
Xolotrema palliata, Tryon.
Triodopsis tridentata, Say. *Rochester.*
Triodopsis lunula, Raf.
Triodopsis fallax, Say. *Rochester.*
Vallonia pulchella, Müll. *Pittsford.*
Helix minuta, Say.
" *costata,* Müll.
Vallonia minuta, Morse.
" " Tryon.
Stenotrema hirsuta, Say. *Rochester.*
Triodopsis hirsuta, Woodward.
Helix fraterna, Wood.
" *porcina,* Say.
Stenotrema monodon, Rac. *Rochester.*
Helix convexa, Chem.
Helicodonta hirsuta, Fer.
Stenotrema monodon var. fraterna, Say. *Rochester.*
Stenotrema monodon var. Leaii, Ward. *Rochester.*

*This is an European species and was picked up near Vick's greenhouses. It was in my possession alive for several days. Possibly it was brought over with some bulbs or plants from England or France.

Patula alternata, Say. *Rochester.*
Anguispira alternata, Morse.
Helix scabra, Lan.
" *strongylodes*, Pfr.
" *mordax*, Shutt.
" *dubia*, Shepp.
Patula perspectiva, Say. *Pittsford.*
Helix patula, Desh.
Anguispira perspectiva, Tryon.
Patula striatella, Anth. *Pittsford.*
Helix ruderata, Ad.
" *Cronkhitei*, Neroc.
Anguispira striatella, Tryon.
Patula Cronkhitei, Tryon.
Strobila labyrinthica, Say. *Pittsford.*
Helicodiscus lineatus, Say. *Rochester.*
Planorbis parallela, Say. ?
Hyalina lineata, Bin.

Family LIMACIDÆ.

***Limax maximus**, Lin. (pl. 4, fig. 4.) *East Rochester.*
Limax antiquorum, Fer.
***Limax flavus**, Lin. (pl. 4, fig. 1.) *East Rochester.*
Limax variegatus, Drap.
***Limax agrestis**, Lin. (pl. 4, fig. 2.)
Limax tunicata, Gld.
Limax campestris, Bin. (pl. 4, fig. 3.) *East Rochester.*
Limax campestris var. occidentalis, Cooper.
Tebennophorus caroliniensis, Bosc. (pl. 4, fig. 6.) *Pittsford.*
Limax togata, Gld.
Phylomicus carolinensis, Fer.
Limax marmoratus, De Kay.
Tebennophorus dorsalis, Bin. (pl. 4, fig. 5.)

As regards the habits of our land snails, their home is in the open woodlands of beech, birch, oak and maple ; they do not frequent the pine lands. I find the *Mesodon albolabris*, *M. thyroides* and *M. Sayii* crawling over the surface of the dead leaves in these woods ; the *Zonites fuliginosa*, *Z. inornata*, *Z. intertexta* and *Macrocyclis concava* invariably under the dead leaves ; the *Triodopsis palliata* favors the

* These three species of *Limax* have been introduced from Europe, and are now plentifully rep-esented in our greenhouses and gardens. Our native species prefer the wooded ravines.

ravines, preferring the underside of a projecting mossy log, where may be found also our native slugs ; the *Patula alternata* loves the underside of dead stumps in wet places and also the clefts of shaly ledges where there is considerable moisture ; the *Stenotrema monodon*, *S. hirsuta* and *Patula perspectiva* live and thrive under the bark of decaying stumps or old prostrate logs ; I found over eighty specimens of the latter under the bark of one such log and all in fine condition. The smaller species of Helix I find under bark, chips or stones and sometimes among moss.

The general impression concerning the food habits of these snails is that they are vegetable feeders ; this impression obtains doubtless from the well known fact that some of the species are very destructive to young shoots and plants in greenhouses. Dr. Binney, however, calls attention to the carnivorous habit of *Macrocyclis concava*, which without doubt is true, though I have not observed it personally ; he also speaks in another place of a *Mesodon Sayii* devouring its own eggs. Of this cannibal tendency in some of the species I had abundant evidence during the past summer in the *Zonites fuliginosa ;* fully one-third of the specimens of this Helix, taken during a special search of two weeks by myself and pupils, were found devouring shell and animal—sometimes of its own species—but more frequently the young of *Mesodon albolabris*, *M. thyroides*, *M. Sayii* and *Triodopsis palliata.* This was in July and possibly the time of year may have somewhat to do with this habit, as in the case of some seed-eating birds that are known to consume large numbers of insects in the feeding of their young and probably of themselves during the breeding season.

Toward the approach of winter these snails hibernate, burrowing beneath the dense carpet of leaves and under logs for this purpose, where they may be safe from their common enemies and the inclemencies of the coming winter. They may be found in these retreats lying with the mouth of the shell upward, within which the animals have made two or more hard glutinous partitions (epiphragms) before entering upon their long winter's rest. Our native Limaces (snails without shells) are found in similar retreats only partially dormant and protected from extreme cold by a thick coating of mucus which they are able to effuse for this purpose.

Very fine and accurate illustrations of our native Helices are given in W. G. Binney's excellent "Manual of American Land Shells," to which the reader is referred for further details concerning this interesting group of the Mollusca.

Family PUPIDÆ.

Pupa muscorum, Lin. (pl. 5, fig. 1.) *Brighton.*
Pupa badia, Ad.
Pupilla badia, Morse.

Pupa Pentodon, Say. (pl. 5, fig. 2.) *Rochester.*
Pupa curvidens, Gld.
" *Tappaniana,* Ad.
Leucochila pentodon, Morse.
Pupilla pentodon, Tryon.

Pupa contracta, Say. (pl. 5, fig. 3.)
Pupa corticaria, Ppr.
" *deltostoma,* Charp.
Leucochila contracta, Morse.

Pupa corticaria, Say. (pl. 5, fig. 4.) *Pittsford.*
Odostomia corticaria, Say.
Carychium corticaria, Fer.
Leucochila corticaria, Morse.

Pupa rupicola, Say. (pl. 5, fig. 5.)
Pupa procera, Gld.
" *carinata,* Gld.
" *gibbosa,* Kust.
" *minuta,* Say.
Vertico rupicola, Bin.
Leucochila rupicola, Tryon.

Pupa fallax, Say. (pl. 5, fig. 6.) *Rochester.*
Cyclostoma marginata, Say.
Bulimus marginatus, Pfr.
" *fallax,* Gld.
Leucochila fallax, Tryon.
Pupilla fallax, Morse.

Pupa armifera, Say. (pl. 5, fig. 7.) *Rochester.*

Pupa milium, Gld. (pl. 5, fig. 8.)
Pupa milium, Gld.
Vertigo milium, Bin.

Pupa simplex, Gld. (pl. 5, fig. 9.) *Irondequoit.*
Pupa simplex, Gld.
Vertigo simplex, Stimpson.

***Vertigo ovata,** Say. (pl. 5, fig. 10.)
Vertigo tridentata, Wolf.
Pupa ovata, Gld.
" *modesta*, Say.
" *ovulum*, Pfr.
Isthmia ovata, Morse.

Carychium exiguum, Say. (pl. 5, fig. 11.) *Rochester.*

Family STENOGYRIDÆ.

Ferussacia subcylindrica, Lin. (pl. 2, fig. 12.) *East Rochester.*
Helix lubrica, Müll.
Bulimus lubricus, Drap.
Achatina lubrica, Pfr.
Zua lubrica, Leach.
Cionella lubrica, Jeff.
Zua subcylindrica, Tryon.
Cionella subcylindrica, Bin.
Bulimus lubricoides, Stimp.
Zua lubricoidea, Morse.
Ferussacia subcylindrica, Bin.

Family SUCCINEIDÆ.

Succinea ovalis, Gld. (pl. 2, fig. 13.) *Charlotte.*
Succinea Decampii, Tryon.
" *calumetensis*, Calk.

Succinea avara, Say. (pl. 2, fig. 15.) *Rochester.*
Succinea Wardiana, Lea.
" *vermeta*, Say.

Succinea obliqua, Say. (pl. 2, fig. 16.) *Pittsford.*
Succinea lineata, De Kay.
" *campestris*, Gld.
" *Greerii*, Tryon.

***Succinea Totteniana,** Lea. (pl. 2, fig. 17.)

Succinea aurea, Lea. (pl. 2, fig 14.) *Rochester.*

Family LIMNÆIDÆ.

Limnæa stagnalis, Lin. (pl. 6, fig. 9.) *Brighton.*
Limnæa jugularis, Say.
" *appressa*, Say.
" *speciosa*, Zieg.

* Reported by Mrs. Olney, as being found in or near Rochester.

Limnæa reflexa, Say. (pl. 6, fig. 5, 6.) *Rochester.*
Limnœa elongata, Say.
" *umbrosus,* Say.
" *exilis,* Lea.
" *distortus,* Ross.

Limnæa elodes, Say. (pl. 6, fig. 1, 2.) *Erie canal.*
Limnœa fragilis, Hald.
" *palustris,* Müll.
" *Nuttalliana,* Lea.
" *plebeia,* Gld.
" *expansa,* Hald.

Limnæa pallida, Ad. (pl. 6, fig. 12, 13.) *Erie canal.*
Limnœa pallida, Hald.
" " De Kay.

Limnæa caperata, Say. *Pittsford.*

Limnæa catascopium, Say. (pl. 6, fig. 10, 11.) *Rochester.*
Limnœa cornea, Val.
" *pinguis,* Say.
" *virginiana,* Lam.
" *sericata,* Zieg.

Limnæa columella, Say. (pl. 6, fig. 3, 4.) *Erie canal.*
Limnœa chalybea, Gld.
" *macrostoma,* Say.
" *acuminata,* Ad.
" *navicula,* Val.
" *strigosa,* Lea.
" *coarctata,* Lea.
" *casta,* Lea.
" *succiniformis,* Ad.
" *columellaris,* Ad.

Limnæa desidiosa, (pl. 6, fig. 7, 8.)

Physa gyrina, Say. (pl. 6, fig. 16, 17.) *Erie canal.*
Physa elliptica, Lea.
" *Hildrethiana,* Lea.

Physa ancillaria, Say. (pl. 6, fig. 18, 21.) *Rochester.*
Physa obesa, De Kay.

Physa heterostropha, Say. (pl. 6, fig. 14, 15.) *Rochester.*
Physa fontana, Hald.
" *cylindrica,* Roe.
" *aurea,* Lea.

Physa plicata, De Kay.
" *osculans*, Hald.
" *striata*, Mke.
" *subarata*, Mke.
" *Charpentieri*, Kust.
" *Philippi*, Kust.
" *inflata*, Lea.
Bulla crassula, Dill.
Cochlea neritoides, List.

Bulimus hypnorum, Lin. (pl. 6, fig. 22.) *Pittsford.*
Physa elongata, Say.
" *glabra*, De Kay.
" *elongatina*, Lewis.
" *turrita*, Sowb.
Aplexa hypnorum, Chem.

Planorbis trivolvis, Say. (pl. 7, fig. 1, 4.) *Charlotte.*
Bulla fluviatilis, Say.
Planorbis regularis, Lea.
" *megasoma*, De Kay. (pl. 7, fig. 5.)
" *corpulentus*, De Kay. (pl. 7, fig. 10.)
" *proboscideus*, Pott.
" *lentus*, Gld.
Cochlea triumorbium, List.

Planorbis campanulatus, Say. (pl. 7, fig. 7, 8.) *Pittsford.*
Planorbis bellus, Lea
" *bicarinatus*, Sowb.
Helix angulata, Shepp.

Planorbis bicarinatus, Say. (pl. 7, fig. 9.) *Rochester.*
Planorbis engonatus, Con.
Helix angulata, Rack.

Planorbis deflectus, Say. (pl. 7, fig. 11.) *Brighton.*
Planorbis virens, Ad.
" *obliquus*, De Kay.

Planorbis parvus, Say. (pl. 7, fig. 6.) *Charlotte.*
Planorbis concavus, Anth.
" *elevatus*, Ad.

Segmentina armigera, Say. (pl. 7, fig. 12.) *Brighton.*

Ancylus rivularis, Say. (pl. 7, fig. 14.) *Genesee river.*

Ancylus tardus, Say. (pl. 7, fig. 13.) *Irondequoit.*

Ancylus parallelus, Hald. (pl. 7, fig. 15.) *Charlotte.*

Class PELECYPODA.

The Unionidæ form a large and distinct group in this class of Mollusca and are generally known under the common names of "river clam," or "river mussel."

Dr. Lea, the great authority on this interesting family, enumerates over eleven thousand recent species and divides them into nine subgenera; three of which, *Unio*, *Margaritana* and *Anodonta* are represented in the United States by about seven hundred and thirty species; a little over one half of the whole number.

There is scarcely a lake, river or creek in this broad country but can furnish some specimens of this bivalve, and often a mere streamlet that one may step over has become the habitat of one or more species. Monroe County having a lake frontage bounding it on the north, with several bays, inlets and creeks; the Genesee river flowing from the southward; and the Erie canal winding through from west to east with its own special fauna, furnishes at least thirty species of this family.

The shells of these molluscs, like bivalves generally, are distinguished by the presence, number and character of certain processes called teeth, which interlock each other under the apex and dorsal margin. In the *Unio* there are 1.2 or 2.2 central, and 1.2 lateral teeth; in *Margaritana* 1.2 central and no laterals; and in *Anodonta* the teeth are absent or almost obsolete. By these features we may determine the genus of a so-called river mussel. (See plate 8, figs. 1, 2, 3.)

River and lake fishing for these molluscs is best accomplished with a row boat and hand net in the fall of the year, when the water is low and the shells have attained the season's growth. The most favorable time for canal work is in the spring as soon as weather will permit, it being customary every year about the month of March to run off the water in order to make any necessary repairs, leaving only a foot or so of mud and water at the bottom. At such times whatever the canal contains can be easily seen and secured. It is a delightful pastime in the sunny days of early spring to traverse the canal and follow in the wake of the musk rat, and if possible forestall him in the appropriation of some choice living specimen; for a shell to be perfect should be taken alive, before the rat has made his dinner of it or the sun has bleached the empty shell.

Dr. Isaac Lea in his great work on the Unionidæ in thirteen folio volumes, gives elaborate lithographic figures of the species. Some of our local Unios are finely illustrated in color by DeKay in his "Mollusca of New York State."

Family UNIONIDÆ.

Unio alatus, Say. *Erie canal.*
Mya alata, Wood.
Lymnadia alata, Sowb.
Metaptera alata, Stimp.

Unio cariosus, Say. *Erie canal.*
Unio ovata, Val.
" *oratus*, Con.

Unio complanatus, Sol. *Genesee river.*
Mya purpurea, Eaton.
Unio purpureus, Say.
" *violaceus*, Speng.
" *purpurascens*, Lam.
" *Georgina*, Lam.
" *fluviatilis*, Green.
" *tortuosus*, Sowb.

Unio gracilis, Bar. *Erie canal.*
Unio planus, Bar.
" *fragilis*, Swain.

Unio gibbosus, Bar. *Erie canal.*
Unio mucronatus, Bar.
" *nasuta*, Lam.
" *dilatatus*, Con.

Unio iris, Lea. *Erie canal.*
Unio subrostratus, Say.
" *nebulosus*, Con.

***Unio novi-eboraci**, Lea. *Erie canal.*
Unio opalinus, Anth.

Unio nasutus, Say. *Erie canal.*
Unio rostratus, Val.
Mya nasuta, Wood.

* This and the preceding are thought to be male and female of the same species.

Unio luteolus, Lam. *Genesee river.*
Unio siliquoideus, Bar.
" *inflatus*, Bar.
" *melinus*, Con.

Unio occidens, Lea. *Erie canal.*
Unio ventricosus, Say.
" *cardium*, Con.

Unio plicatus, Less. *Erie canal.*
Unio peruvianus, Lam.
" *undulata*, Desh.
" *multiplicata*, Desh.
" *crassus*, Bar.
Mya plicata, Eaton.

Unio pressus, Lea. *Genesee river.*
Unio compressa, Lea.
" *compressus*, Con.

Unio radiatus, Lam. *Genesee river.*
Unio Virginiana, Mke.
" *distans*, Anth.
Mya radiata, Gml.
" *oblonga*, Wood.
" *pictorum tenuis*, Chem.

Unio rectus, Lam. *Erie canal.*
Unio prœlongus, Bar.
" *arquatus*, Con.

Unio rosaceus, De Kay. *Charlotte.*

Unio rubiginosus, Lea. *Genesee river.*
Unio flavus, Con.
" *cerinus*, Con.
Cumicula rubiginosa, Swain.

Unio Tappanianus, Lea. *Genesee river.*
Unio Viridis, Con.

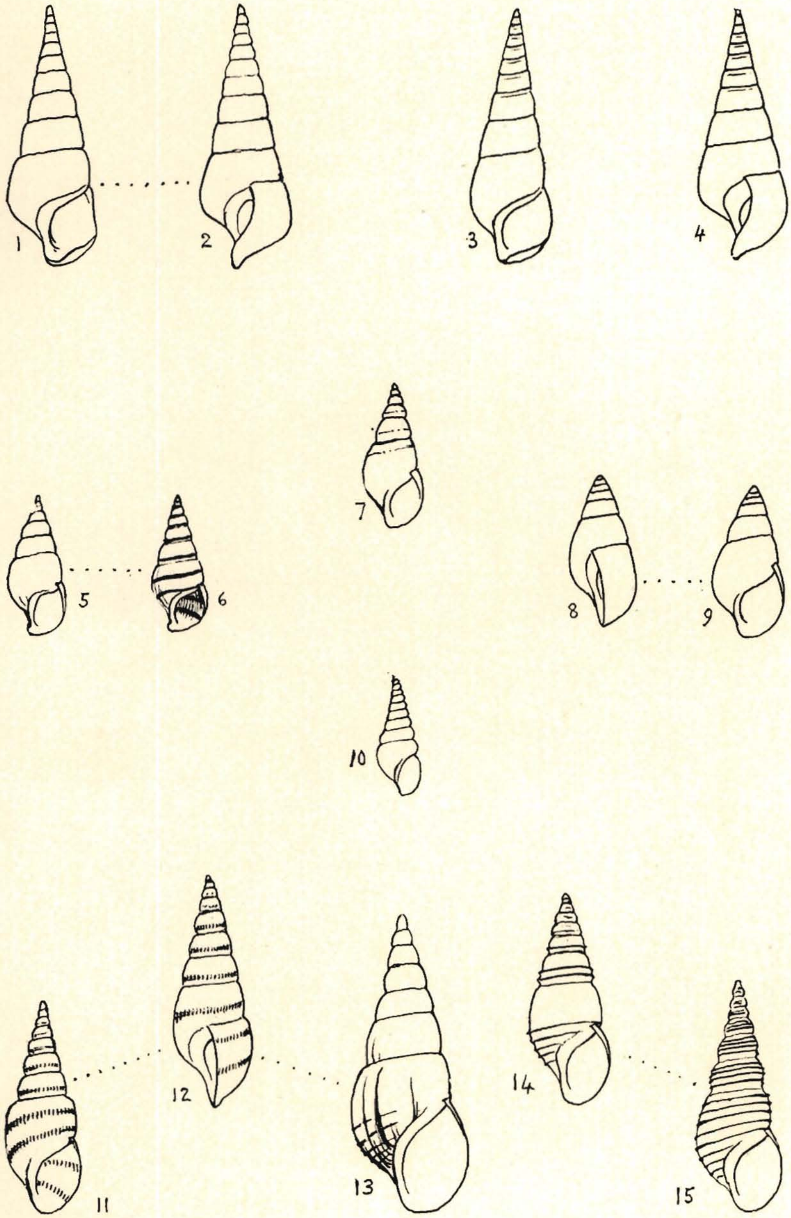
Unio undulatus, Bar. *Erie canal.*
Unio costatus, Raf.
" *plicatus*, Con.
Mya undulata, Eaton.

Margaritana rugosa, Bar. *Genesee river.*
Alasmodonta abducta, Say.
Unio rugosus, Chenu.
Complanaria rugosa, Swain.

Plate 1.

Mollusca of Monroe County.

1, 2.	Pleurocera subulare, Lea.
3.	" subulare var. pallidum, Lea.
4.	" " var. intensum, Lea.
5, 6.	Goniobasis depygis, Say.
7.	" semicarinata, Say.
8, 9.	" livescens, Menke.
10.	" gemma, DeKay. (DeKay's figure) a young subulare.
11, 12, 13.	Goniobasis virginica, Say.
14, 15.	" virginica var. multilineata, Say.



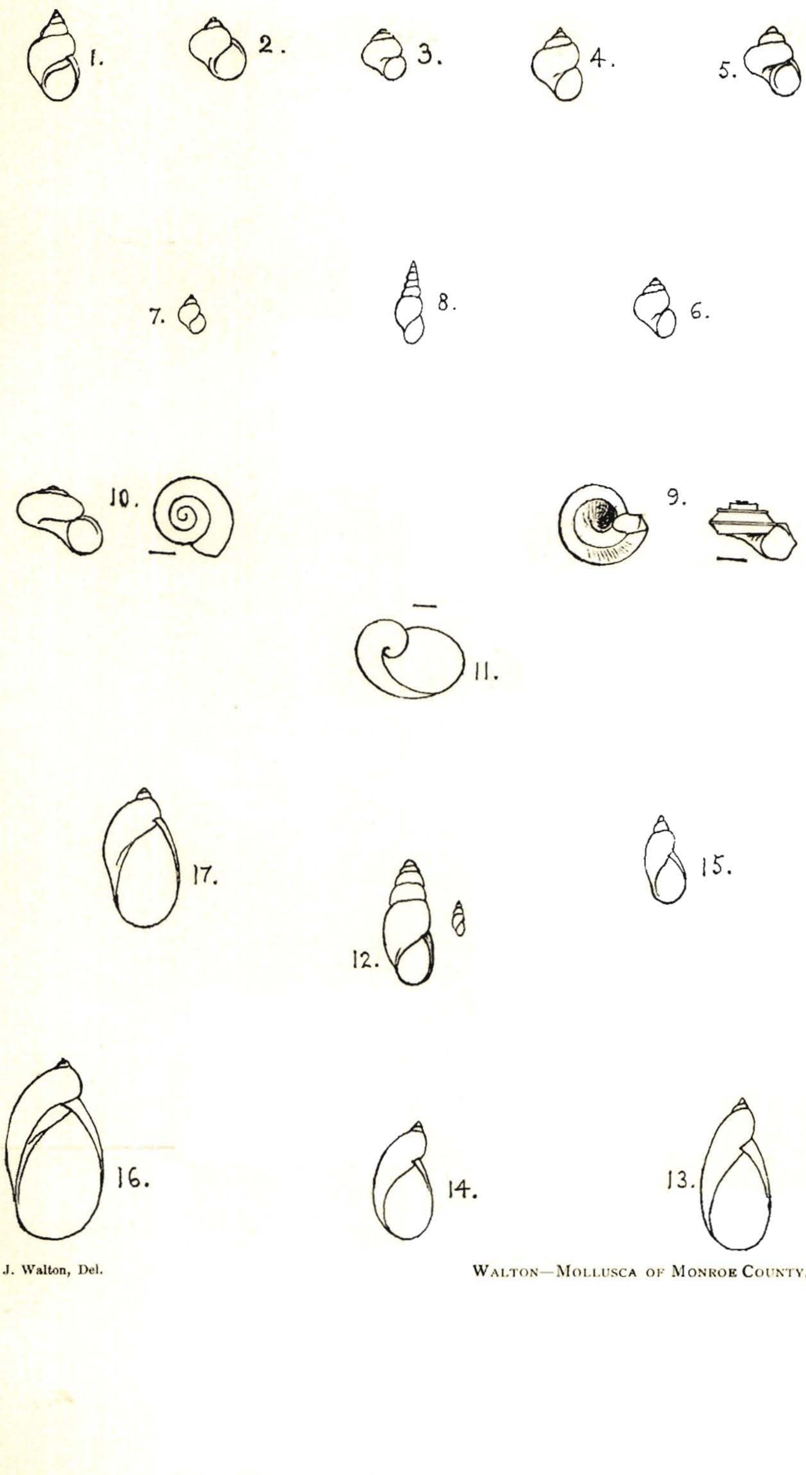
J. Walton, Del.

WALTON—MOLLUSCA OF MONROE COUNTY.

PLATE 2.

Mollusca of Monroe County.

1. Bythinia tentaculata, Lin.
2. Gillia altilis, Lea.
3. Amnicola limosa, Say.
4. " porata, Say.
5. " orbiculata, Lea.
6. " pallida, Hald.
7. " granum, Say.
8. Pomatiopsis lustrica, Say.
9. Valvata tricarinata, Say.
10. " sincera, Say.
11. Vitrina limpida, Gld.
12. Ferussacia subcylindrica, Lin.
13. Succinea ovalis, Gld.
14. " aurea, Lea.
15. " avara, Say.
16. " obliqua, Say.
17. " Totteniana, Lea.



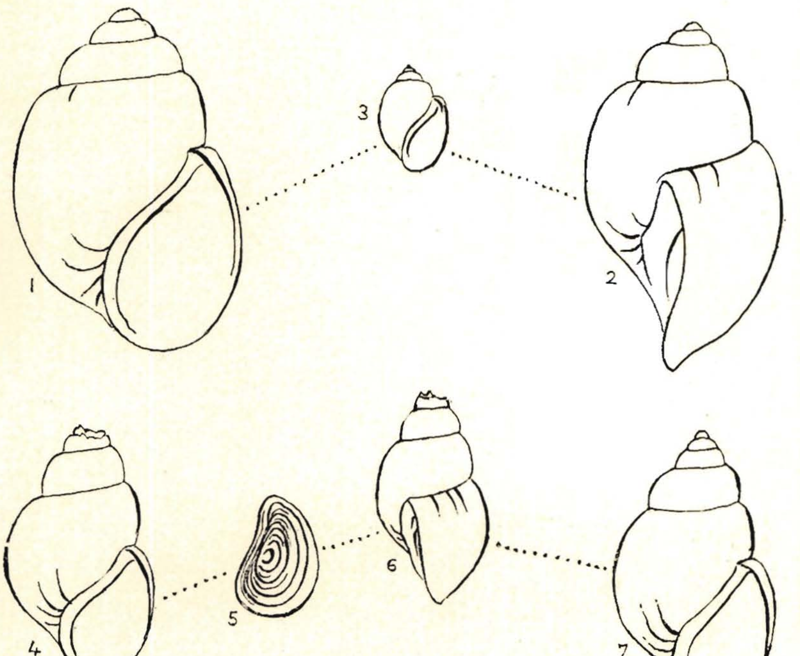
J. Walton, Del.

WALTON—MOLLUSCA OF MONROE COUNTY.

PLATE 3.

Mollusca of Monroe County.

1.	Melantho	ponderosa, Say.
2, 3.	"	ponderosa, Say. After Binney.
4, 5, 6.	"	decisa, Say. Says' figures, after Binney.
7.	"	" Say.
8.	"	rufa, Hald.
9.	"	decisa var. obesa, Lewis. Lewis' type, after Binney.
10.	"	" heterostropha, Kirt.
11, 12.	"	" var. genicula, Con.
13.	"	" var. integra, Say.



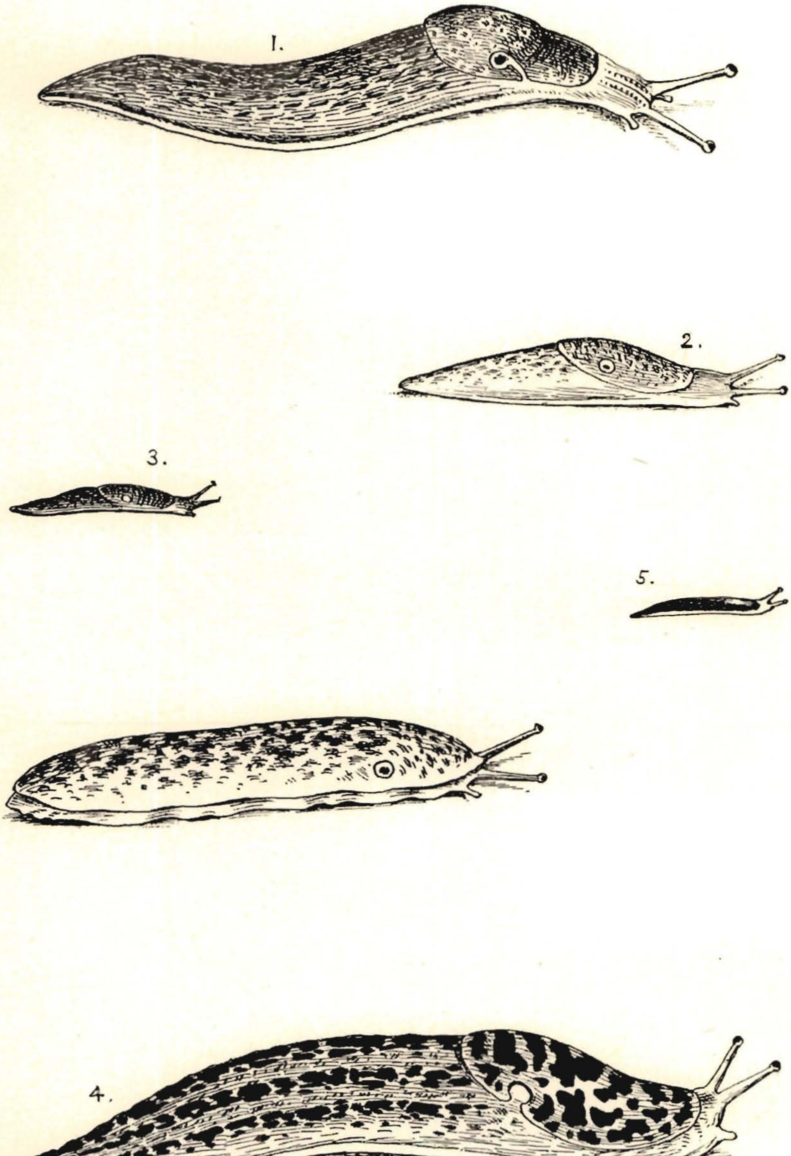
J. Walton, Del.

Walton—Mollusca of Monroe County.

PLATE 4.

Mollusca of Monroe County.

1. Limax flavus, Lin.
2. " agrestis, Lin.
3. " campestris, Bin.
4. " maximus, Lin.
5. Tebennophorus dorsalis, Bin. After Binney's figure.
6. " caroliniensis, Bosc.



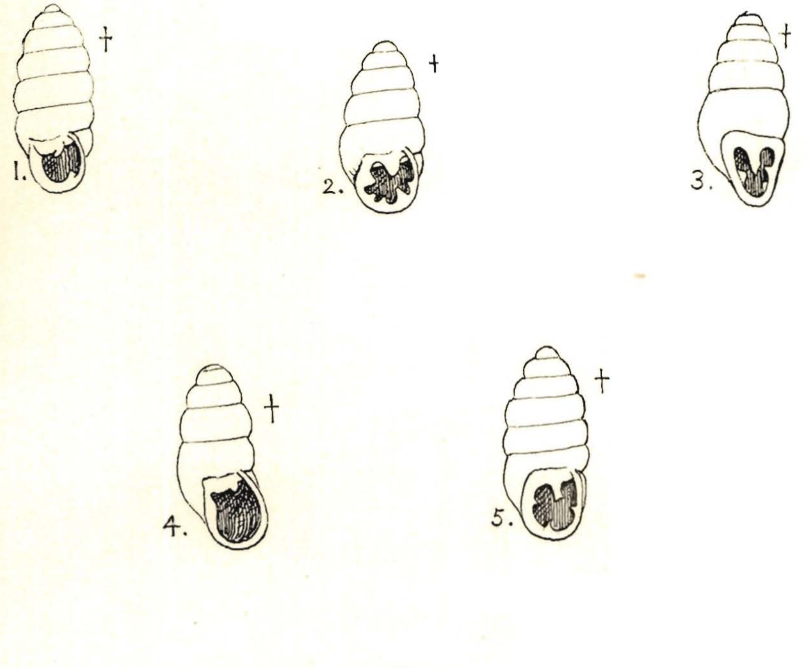
J. Walton, Del.

WALTON—MOLLUSCA OF MONROE COUNTY.

PLATE 5.

Mollusca of Monroe County.

1. Pupa muscorum, Lin.
2. " pentodon, Say.
3. " contracta, Say.
4. " corticaria, Say.
5. " rupicola, Say.
6. " fallax, Say.
7. " armifera, Say.
8. Vertigo milium, Gould.
9. " simplex, Gld.
10. " ovata, Say.
11. Carychium exiguum, Say.



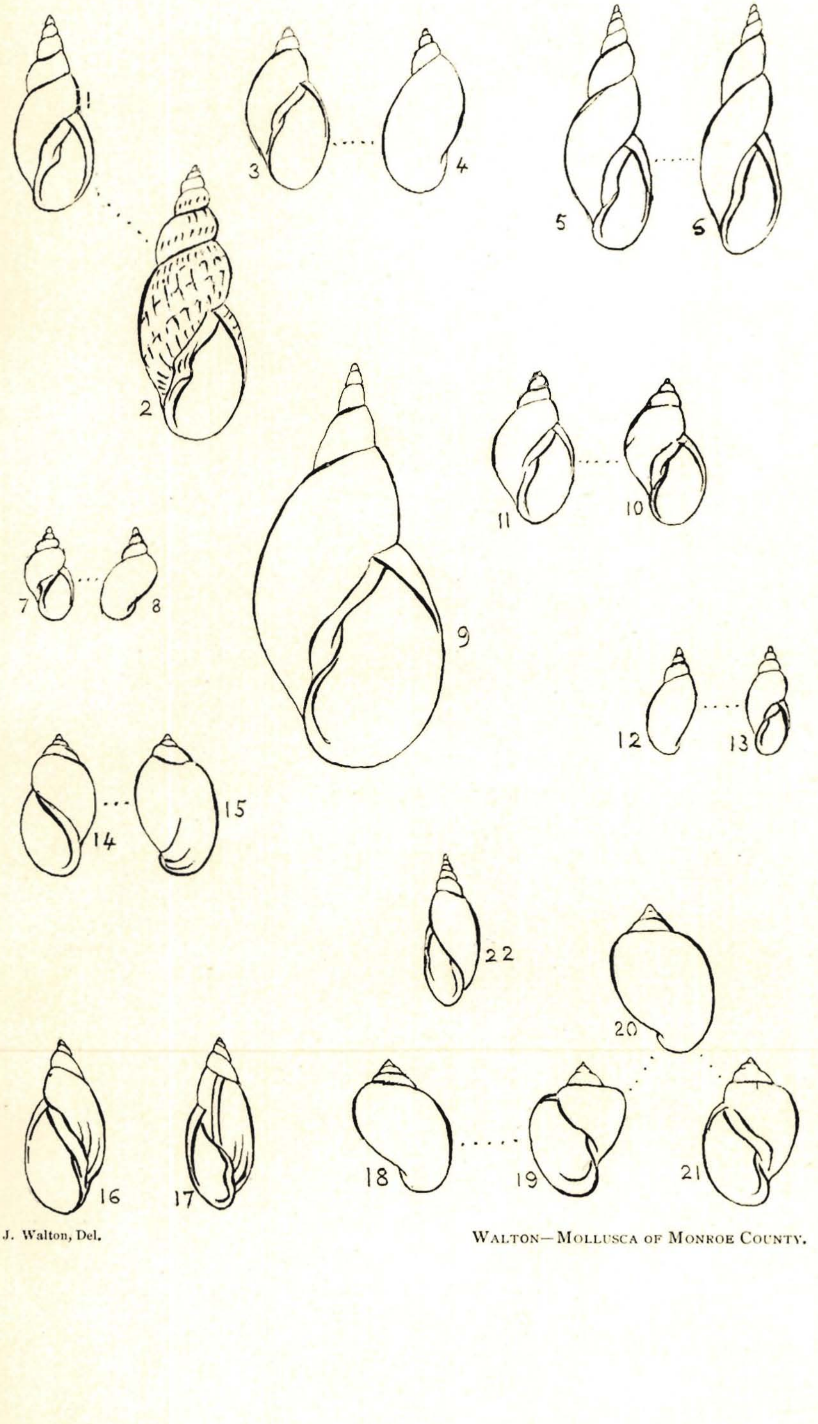
J. Walton, Del.

Walton—Mollusca of Monroe County.

Plate 6.

Mollusca of Monroe County.

1. Limnæa elodes, Say. Say's figure, after Binney.
2. " " Say.
3, 4. " columella, Say.
5. " umbrosa, Say.
6. " reflexa, Say. Say's figure, after Binney.
7, 8. " desidiosa, Say.
9. " stagnalis, Lin.
10, 11. " catascopium, Say.
12, 13. " .pallida, Ad.
14, 15, Physa heterostropha, Say.
16. " gyrina, Say.
17. " " var. Hildrethiana, Lea. Lea's figure, after Binney.
18–21. Physa ancillaria, Say.
22. Bulimus hypnorum, Lin.



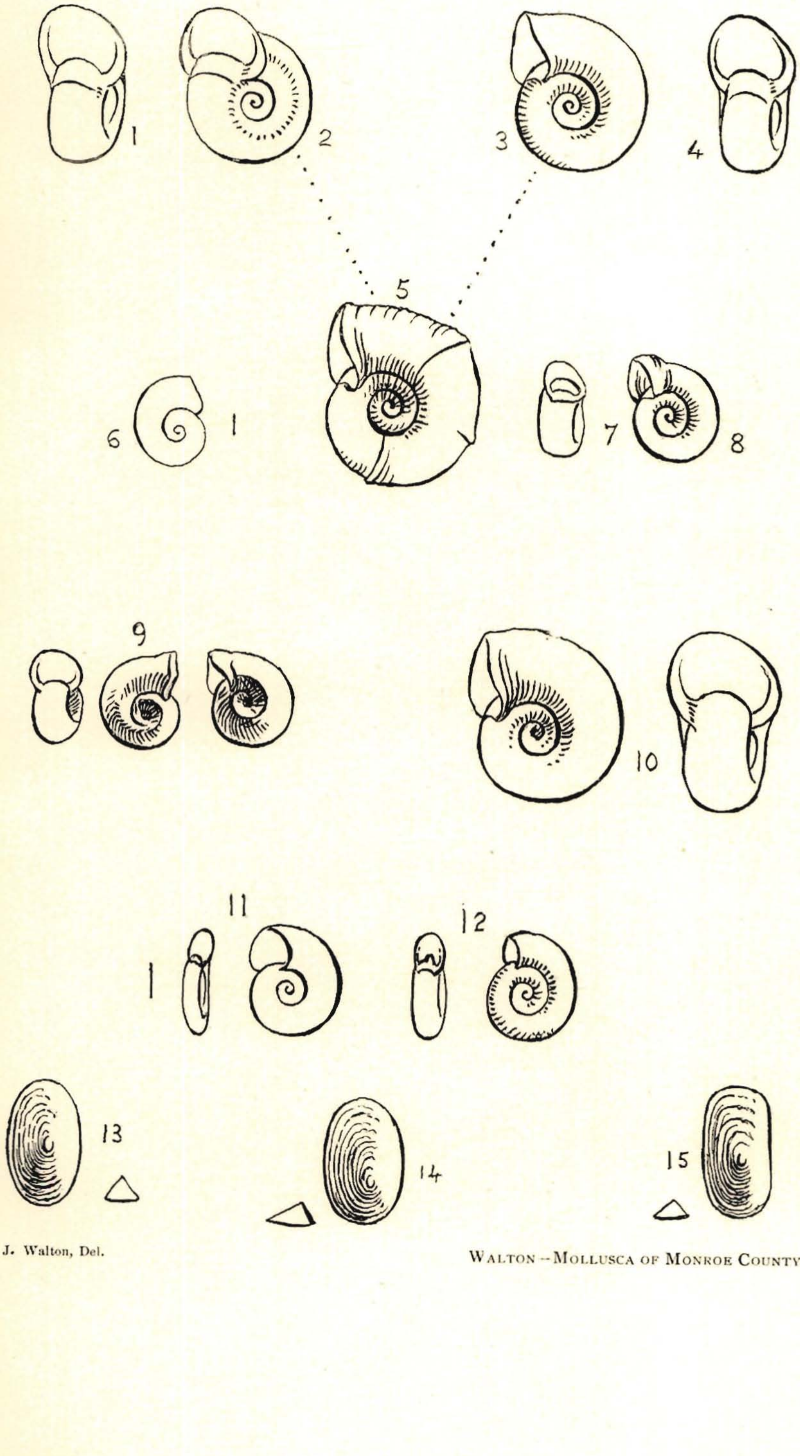
J. Walton, Del.

WALTON—MOLLUSCA OF MONROE COUNTY.

Plate 7.

Mollusca of Monroe County.

1, 2.	Planorbis	trivolvis, Say. Say's figure, after Binney.
3, 4.	"	trivolvis, Say.
5.	"	megasoma, De Kay.
6.	"	parvus, Say.
7, 8.	"	campanulatus, Say.
9.	"	bicarinatus, Say.
10.	"	corpulentus, De Kay.
11.	"	deflectus, Say.
12.	Segmentina armigera, Say.	
13.	Ancylus tardus, Say.	
14.	" rivularis, Say.	
15.	" paralellus, Hald.	



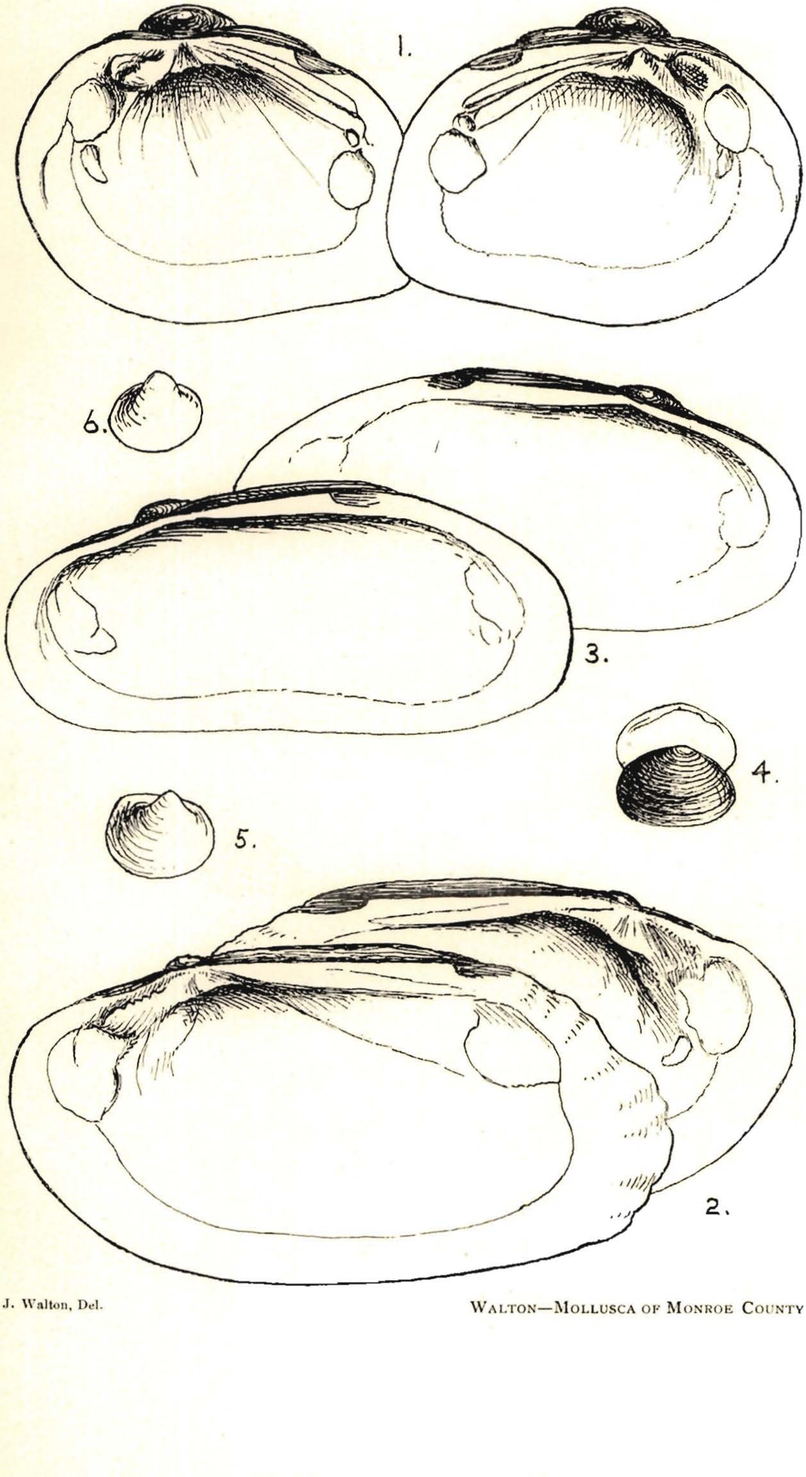
J. Walton, Del.

WALTON--MOLLUSCA OF MONROE COUNTY.

Plate 8.

Mollusca of Monroe County.

1. Unio rubiginosus, Lea.
2. Margaritana rugosa, Bar.
3. Anodonta subcylindracea, Lea.
4. Sphærium similis, Say.
5. " partumeium, Say.
6. Pisidium variabile, Prime.



J. Walton, Del.

Margaritana deltoidea, Lea. *Erie canal.*
Alasmodonta deltoidea, Chenu.

Margaritana marginata, Say. *Erie canal.*
Alasmodonta truncata, Say.
Unio varicosa, Lam.
" *calceolus,* Say.
Alasmodonta corrugata, De Kay.

Anodonta Benedictii, Lea. *Erie canal.*
Anodonta cultrata, Gld.

Anodonta edentula, Say. *Long Pond.*
Anodonta areolata, Swain.
" *unadilla,* De Kay.
Alasmodonta rhombica, Anth.
Hemiodon areolatus, Swain.

Anodonta excurvata, De Kay. *Pittsford.*

Anodonta Ferussaciana, Lea. *Erie canal.*
Alasmodonta Ferussaciana, Kust.

Anodonta ferruginea, Lea. *Genesee river.*

Anodonta fluviatilis, Dill. *Allen's creek.*
Anodonta cataracta, Say.
" *marginata,* Say. Ads.

Anodonta fragilis, Lam. *Pittsford.*
Anodonta pallida, Anth.
" *imbricata,* Anth.
" *flava,* Anth.
" *glandulosa,* Anth.
" *irisans,* Anth.
" *subcarinata,* Currier.

Anodonta imbecillis, Say. *Irondequoit creek.*
Anodonta incerta, Lea.
" *horda,* Gld.

Anodonta implicata, Say. *Charlotte.*
Anodonta Newtoniensis, Lea.
" *implicata,* Gld.

Anodonta Lewisii, Lea. *Erie canal.*

Anodonta salmonia, Lea. *Erie canal.*

Anodonta subcylindracea, Lea. *Irondequoit creek.*

Anodonta undulata, Say.
Anodonta rugosus, Swain.
" *Pennsylvanica*, Lam.
Unio undulata, Desh.
Strophitus undulatus, Stimp.

Unio rosaceus is quite local. I have found it only at Long Pond and the margin of Lake Ontario, between Long Pond and Charlotte. De Kay's figures are very characteristic of all I have collected.

All our local species are found also in the canal and generally in much better condition than elsewhere, owing partly to the fact that the bottom of the canal is covered with a fine sediment of mud and partly to the quiet condition of the water.

The shells found in the canal only are common in the large lakes and their tributaries west of us, and doubtless reach here in their young state with the influx of the water in spring-time when the Erie canal is replenished.

Family CYRENIDÆ.

Sphærium similis, Say. (pl. 8, fig. 4.) *Erie canal.*
Sphærium partumeium, Say. (pl. 8, fig. 5.) *Genesee river.*
Pisidium variabile, Prime. (pl. 8, fig. 6.) *Brighton.*

The paper was illustrated by a collection of the shells of the various species, which collection Mr. Walton presented to the Academy.

Remarks were made upon the paper by Dr. Anna H. Searing, Mr. J. E. Putnam and the President.

A vote of thanks was tendered Mr. Walton for his valuable gift of the collection of Monroe County shells to the cabinet of the Academy.

Mr. J. E. Putnam discussed a recent paper in the Engineering News, on incandescent electric lighting.

NOVEMBER 9, 1891.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Sixty persons present.

The Council report recommended :

(1.) The payment of certain bills.

(2.) The election of the following candidates as resident members :

PROFESSOR ARTHUR L. BAKER,
MR. WALTER B. SMITH.

The bills were ordered paid, and the candidates were elected by formal ballot.

The President, PROFESSOR H. L. FAIRCHILD, presented a paper on

THE ORIGIN, STRUCTURE AND HISTORY OF MOUNTAINS.

The paper was illustrated by blackboard diagrams and lantern views.

NOVEMBER 23, 1891.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Forty-five persons present.

The following paper was read by title :

NOTES ON A COLLECTION OF SHELLS FROM THE MAURITIUS; WITH A CONSIDERATION OF THE GENUS MAGILUS OF MONTFORT.

BY FRANK C. BAKER.

Several months ago I had occasion to study a large collection of shells from the Island of Mauritius. These were nearly all fresh, live specimens, in many cases with the opercula *in situ*, and with the epidermis intact. The collection numbers some two hundred and fifty species, represented, in most cases, by a score or more individuals.

Many of the species enumerated have a very wide geographical distribution ; as for example *Aplustrum physis*, found abundantly throughout the West Indies ; and a number of the Cypræidæ, which are common to both the Mauritius and the New Caledonian Archipelago.

Unlike the larger island to the west, Madagascar, the Mauritius has very few species peculiar to itself, and those that are peculiar are mostly confined to the families Testacellidæ and Limacidæ. I believe the present collection to embody a larger number of species, represented by more numerous individuals, than any previous collection which has come to this country from this locality, and I feel that I have been especially favored in having the opportunity of studying it. I trust the following catalogue may be of some assistance to my brother students, who may be working upon the fauna of this interesting region.

Class GASTROPODA.

Order PULMONATA.

Family TESTACELLIDÆ.

1. **Gibbus Lyonetianus,** *Pallas*. Said to be somewhat rare.
2. " **(Goniodomus) pagodus,** Fér.
3. " **(Plicadomus) sulcatus,** Müller.
4. " " **Newtoni,** H. Adams.
5. " **(Gonospira) modiolus,** Fér.
6. " " **Mondraini,** H. Adams.
7. " " **Barclayi,** H. Adams.
8. " " **mauritianus,** Morelet.
9. " " **modiolinus,** Morelet.
10. " " **teres,** Pfr.
11. " " **bacillus,** Pfr.
12. " " sp.

Of the forty-eight species of Gibbus (not including the subgenus *Ennea* H. & A. Adams) known to science, twenty-one inhabit the Mauritius. All of the foregoing species are found abundantly distributed throughout the island.

Family LIMACIDÆ.

13. **Ariophanta (Cœlatura) scalpta,** *Martens.*

14. " **(Rotula) argenta,** Reeve.

15. " " **semicerina,** Morelet.

16. " " **implicata,** Nevill. An unfigured species said to be quite rare.

17. **Ariophanta (Pachystyla) inversicolor,** Fér. Very common.

18. **Ariophanta (Pachystyla) mauritiana,** Pfr. (=*leucostyla*, Pfr., which is the adult form, *mauritiana* having been described from a juvenile specimen.) Very common, associated with the preceding.

19. **Ariophanta (Caldwellia) philyrina,** Morelet. Rare.

It is rather unfortunate that the old and well-known name *Nanina* should have been changed to *Ariophanta*. *Nanina*, Gray, however, was described in 1834, while *Ariophanta*, des Moulins, was described in 1829, thus making the change necessary.

Family AURICULIDÆ.

20. **Melampus** sp. An abundant form which I have not been able to identify. It has much the appearance of *Melampas cylinaroides*, Mousson, from the Marquesas, but is not as elongate and has a much shorter aperture than that species.

Order OPISTHOBRANCHIATA.

Family APLUSTRIDÆ.

21. **Aplustrum aplustre,** Linn.

22. " **(Hydatina) physis,** Linn.

23. " **(Bullina) scabra,** Chemn. All very common. *Aplustrum physis* is also found in the West Indies.

Family BULLIDÆ.

24. **Acera soluta,** Chemn.

25. **Volvatella Cumingii,?** A. Adams. Found sparingly.

Family APLYSIIDÆ.

26. **Dolabella Rumphii,** Cuvier.

27. " **gigas,** Rang.

Both forms occur very abundantly.

Family UMBRELLIDÆ.

28. **Umbrella indica,** Lam. Very common.

Order CTENOBRANCHIATA.

Family TEREBRIDÆ.

29. **Terebra cingulifera,** Lam. Common.

30. " **cerithina,** Lam. This appears to be a very variable species if one can judge from the material at hand.

31. **Terebra duplicata,** Linn.

32. " **penicillata,** Hinds, var. **venosa,** Hinds. Quite abundant.

Family CONIDÆ.

33. **Conus musicus,** Hwass.

34. " **textile,** Linn., var. **archiepiscopus,** Hwass.

35. " **miliaris,** Hwass, var. **abbreviatus,** Nuttall.

36. " **propinquus,** Smith, (=*tenuisulcatus,* Sowb., preoccupied.)

37. **Conus rattus,** Hwass.

38. " **cernicus,** H. Adams, (does not = *balteatus* Sowb., as considered by some authors.)

39. **Conus catus,** Hwass.

40. " **varius,** Linn.

41. " **Janus,** Hwass. Very rare.

42. " **omaria,** Hwass.

" **omaria,** Hwass, var. **columbrinus,** Lam. Very rare.

43. **Conus Hebræus,** Linn.

" **Hebræus,** Linn., var. **vermiculatus,** Hwass.

44. " **maldivus,** Hwass.

45. " **lithoglyphus,** Meuschen.

46. " **miles,** Linn.

47. " **lividus,** Hwass.

48. " **quercinus,** Hwass.

49. " **betulinus,** Linn.

50. " **virgo,** Linn.

51. " **literatus,** Linn.

52. " **arenatus,** Hwass.

53. " **tessellatus,** Born.

54. " **striatus,** Linn.

55. " **imperialis,** Linn., var. **fuscatus,** Lam.

I am inclined to believe that the variety *viridulus*, Lam., should become a synonym of this variety.

The Mauritius seems to be the metropolis, almost, of the cones, for they are found there in great numbers, both as regards species and individuals. The specimens received from there seem to be in better condition than those received from other localities. All of the species enumerated above were received in considerable quantity.

Family PLEUROTOMIDÆ.

56. **Surcula bijubata,** Reeve. Common.

57. **Drillia** sp.

58. " **(Clavus) echinata,** Lam. Not common.

59. **Clathurella Robillardi,** Barclay.

Family CANCELLARIIDÆ.

60. **Cancellaria (Trigonostoma) scalata,** Sowb. Very common.

Family OLIVIDÆ.

61. **Oliva episcopalis,** Lam. The specimens before me show a great range of variation.

62. **Oliva irisans,** Lam., var. **erythrostoma**, Lam., (=*ponderosa*, Duc.)

63. **Oliva irisans,** Lam., var. **tremulina**, Lam. I have before me two distinct varieties of this species ; one light, with the zigzag markings very distinct, and the other very dark, almost black, so that the markings are scarcely visible.

64. **Oliva** sp. A distinct little shell, but one that I am unable to determine by any of the monographs. It is about an inch in length, of a cream color, with purple, zigzag, longitudinal lines. The interior of the aperture is salmon-colored. The shell looks as though it might be a young *irisans* var. *erythrostoma.*

65. **Ancilla (Anolacia) mauritiana,** Sowb., (= *torosa*, Meuschen.) A very common Mauritian species.

Family HARPIDÆ.

66. **Harpa minor,** Lam. Quite abundant.

Family MITRIDÆ.

67. **Mitra variegata,** Reeve.

68. " **eximia,** A Ad.

69. " **(Swainsonia) filum,** Wood.

70. " " **fissurata,** Lam.

71. " **(Cancilla) flammea,** Quoy.

72. " " **interlirata,** Reeve.

I should hardly include this in the synonomy of *flammea* as Tryon has done. The two shells seem, to me, to be quite distinct.

73. **Mitra (Cancilla) filaris,** Linn. Very common and large. There have been numerous varietal names attached to the various forms of this species, but I cannot see any differential characters. The species is indiscriminately long, short, thin or thick and I can see no good lines of demarcation.

74. **Mitra (Chrysame) ferruginea,** Lam. Quite abundant.

75. **Mitra (Chrysame) pellis-serpentis,** Reeve. A species subject to much variety.

76. **Mitra (Chrysame) turgida,** Reeve.

77. " " **tabanula,** Lam.

78. " " **coronata,** Lam.

79. " " **brumalis,** Reeve.

80. " **(Strigatella) acuminata,** Swains.

81. " " **tigrina,** A. Adams.

82. " " **litterata,** Lam.

83. **Dibaphus Philippii,** Crosse, (= *edentulus*, Swain.)

84. **Turricula lyrata,** Linn. A very common species.

85. " **(Costellaria) speciosa,** Reeve. Rare.

86. " " **militaris,** Reeve, var. **lubens,** Reeve.

87. **Turricula (Costellaria) clathrata,** Reeve.

88. " " **scitula,** A. Adams.

89. " " **Deshayesii,** Reeve.

I have before me a light and a dark variety of this species.

90. **Turricula (Pusia) gemmata,** Sowb.

No habitat is given in any of the monographs for this species.

91. **Turricula (Pusia) aureolata,** Swains.

92. " " **rubra,** Swains.

93. " " **pardalis,** Küster.

94. " " **nodosa,** Reeve.

95. **Cylindra crenulata,** Gmel.

The Mauritius seems to be the metropolis of the Mitridæ fully as much as of the Conidæ. Most of the species enumerated above are quite common, and are received from there in considerable quantities.

Family FASCIOLARIIDÆ.

96. **Fasciolaria (Pleuroploca) trapezium,** Linn.

Quite common. I have before me several large and fine specimens, measuring fully eight inches in length. This species is subject to some variety and on this account several specific names have been given to it, but they are seen to intergrade when an abundance of material is examined and the names therefore cannot stand.

97. **Latirus polygonus,** Gmel. Common.

98. " sp. Common.

99. " **(Peristernia) nassatula,** Lam.

A common shell. subject to extreme variation.

100. **Latirus (Peristernia) incarnata,** Desh. Common.

Family BUCCINIDÆ.

101. **Tritonidea undosa,** Swains.

102. **Pisania marmorata,** Reeve.

103. " **ignea,** Gmel.

All three of the above forms are abundantly represented. The specimens of *Tritonidea undosa* are exceptionally large and fine, and covered by a short, brown, silky epidermis.

Family NASSIDÆ.

104. **Buccinanops (Bullia) mauritiana,** Gray.

A very characteristic species, distinguished at once by the double callous running round the whorls, one above and one below the suture ; the whorls are flat-sided instead of being rounded as in the nearly related species. *Buccinopsis Grayi*, Reeve, is probably synonymous.

105. **Nassa coronata,** Brug.

The characteristic light spiral bands, one above and one below the periphery, are not always developed, and the shell is then of a light drab color. The columellar callous is very large and spreading in the specimens before me.

106. **Nassa (Alectrion) hirta,** Kien., var. **crenulata,** Reeve.

I can scarcely consider *crenulata* an absolute synonym of *hirta* as Tryon has done.

107. **Nassa (Alectrion) papillosa,** Linn.

The specimens of this species are very large and fine, measuring nearly two inches in length. The shells are a beautiful flesh-color, and the columellar callous spreads over a considerable portion of the shell. They are much finer than any I have seen from any other locality.

108. **Nassa (Zeuxis) tænia.** Quite common and very large.

109. **Nassa (Zeuxis) gaudiosa,** Hinds. A species with upwards of fifteen synonyms.

110. **Nassa (Zeuxis) punctata,** A. Adams. Scarcely a synonym of *gaudiosa.* The shell is much longer in the spire, smoother and of a dark brown, almost black color, while *gaudiosa* is yellowish with reddish markings.

Family COLUMBELLIDÆ.

111. **Columbella turturina,** Lam.

112. " **(Conoidea) tringa,** Lam., (=*undata,* Duclos.) Both forms quite common.

Family MURICIDÆ.

Sub-family MURICINÆ.

113. **Murex (Pteronotus) triqueter,** Born. Very common. Usually received from Mauritius collectors under the name of *Cumingii,* A. Adams.

114. **Ocinebra pumila,** A. Adams. This species has not been heretofore reported from this region. It is a rare form, judging from the limited number of specimens received.

115. **Ocinebra (Favartia) brevicula,** Sowb. Unusually large and heavy.

116. **Trophon (Aspella) anceps,** Lam. A common form. This species has usually been considered a Ranella, but is more properly placed in Trophon on account of its dentition.

Sub-family PURPURINÆ.

117. **Purpura Persica,** Linn.

118. **Iopas sertum,** Brug.

119. **Vexilla vexillum,** Chemn. These three forms were received in considerable quantities.

120. **Pentadactylus digitatus,** Lam.
" " " var. **lobatus,** Blaino.
121. " **(Morula) cancellatus,** Quoy.
122. " " **undatus,** Chemn.

The above four forms seem to be quite common.

Sub-family CORALLIOPHILINÆ.

123. **Coralliophila exarata,** Pease.
124. " **costularis,** Lam.
125. " **(Coralliobia) fimbriata,** A. Adams.
126. " " **Robillardi,** Liénard.

This group (Coralliobia) was made a sub-genus of Concholepas by the Messrs. Adams, but I agree with Fischer (Manuel de Conchyliologie, p. 647), in considering it a sub-genus under Coralliophila. Tryon (Manual of Conchology, p. 217), makes it a synomym of Magilus, a decision in which I can by no means concur. In the material before me, I am able to distinguish two forms, one (*fimbriata*, A. Ad.,) distinguished by heavy spiral ribs and by the apex being visible and a little raised above the body-whorl, while the other (*Robillardi*, Liénard) is distinguished by numerous spiral lines and by the apex being covered by the body-whorl. I have seen a large number of both of these forms and this distinction holds good throughout the entire series.

127. **Magilus antiquus,** Lam.
128. **Leptoconchus Cumingii,** Desh.
129. " **Maillardi,** Desh.

The Magili are well represented, both in species and specimens, from the young individual of paper-like consistency, to the adult animal with a tube nearly or quite a foot in length.

Family IANTHINIDÆ.

130. **Ianthina fragilis,** Lam., var. **trochoidea,** Reeve.
131. " **globosa,** Linn.

Both forms are very abundant. This genus is subject to such extremes of variation, that it is almost an impossibility to give a diagnosis that will cover one form and exclude all the rest. On this account a large number of specific names have been proposed, amounting to fifty or more, but of these only three can be satisfactorily separated as distinct species, with the addition of four varieties.

Family SCALIDÆ.

132. **Scala rubrolineata,** Sowb.

133. " **(Opalia) lamellosa,** Lam. Both very common.

Family EULIMIDÆ.

134. **Stylifer speciosus,** H. Adams.

135. " sp.

136. **Eulima major,** Sowb. Vide Thes. Conch. t. 169, *f* 4. A species received in considerable numbers from Mauritius collectors. *Eulima arcuata*, Sowb., is said to be a synonym.

137. **Eulima Cumingii,** A. Adams.

Family PYRAMIDELLIDÆ.

138. **Pyramidella dolabrata,** Linn., var. **terebellum,** Müll. A common form, very large and with the spiral chocolate-colored bands very deep and conspicuous.

Family TRITONIDÆ.

139. **Triton tritonis,** Linn. Several small specimens averaging six inches in length.

140. **Triton (Simpulum) pilearis,** Linn. A large number received, including the forms *aquatilis*, Reeve, and *intermedius*, Pease, which are by some authors considered distinct. I can see no good characters by which to separate them.

141. **Triton (Simpulum) rubecula,** Linn.

A beautiful set. Some specimens have black blotches between the spiral ribs.

142. **Triton (Simpulum) gemmatus,** Reeve.

143. " **(Cabestana) labiosus,** Wood.

144. " **(Ranularia) tuberosus,** Lam. From the description, I should say that *T. mauritianus*, Tapparone-Canefri, described without figure, should be placed here as a synonym.

145. **Triton (Colubraria) maculosus,** Gmel.

146. " " **obscurus,** Reeve.

147. " " **decapitatus,** Reeve.

148. **Ranella (Lampas) lampas,** Linn.

149. " " **bufonia,** Gmel.

150. " " **cruentata,** Sowb.

151. " " **granifera,** Lam.

152. " " **affinis,** Brod.

I believe the last two species to be synonymous. The only difference seems to be the larger size of the tubercles in *affinis*.

153. **Ranella (Lampas)** sp.

This specimen was covered with stony algæ, and no characters could be made out.

154. **Ranella (Argobuccinum) pusilla,** Brod. A beautiful little species which does not seem to be at all common.

Family CASSIDIDÆ.

155. **Cassis (Casmaria) vibex,** Linn.

Family DOLIIDÆ.

156. **Dolium perdix,** Linn.

This species enjoys a wide distribution, being found in the Indian Ocean, Polynesia, West Africa, West Indies, Brazil and the Mauritius.

Family CYPRÆIDÆ.

157. **Cypræa scurra,** Chemn. Exceptionally large and fine. Not before reported from the Mauritius.

158. **Cypræa fimbriata,** Gmel. The violet painting of the extremities of the shell is very conspicuous.

159. **Cypræa felina,** Gmel.

160. " **hirundo,** Linn.

161. " **Oweni,** Sowb.

These three forms are very common.

162. **Cypræa caurica**, Linn. Dwarfed variety.

163. " **cruenta**, Gmelin.

164. " **stolida**, Linn.

165. " **mauritiana**, Linn. Very common.

166. " **tigris**, Linn. Very large and fine.

167. " **undata**, Lam.

168. " **clandestina**, Linn.

169. " **punctata**, Linn. Very small.

170. " **cribellum**, Gask.

171. " **esontropia**, Ducl.

172. " **Menkeana**, Desh.

173. " **tabescens**, Sol.

174. " **nucleus**, Linn.

175. " **cicercula**, Linn.

176. " **Adansoni**, Gray. Very rare.

177. **Trivia oryza**, Lam.

178. " **tremeza**, Duclos.

Of the two hundred described species of the family, fifty have been reported from this region and twenty-two are included in this catalogue. In examining a collection from New Caledonia I was very much astonished to find a number of species of the Cypræidæ, (as well as other groups) common to both localities; this is quite a range of geographical distribution.

Family STROMBIDÆ.

179. **Strombus (Euprotomus) lentiginosus**, Linn. Very common.

180. **Strombus (Monodactylus) auris-Dianæ**, Linn.

181. " **(Canarium) hæmastoma**, Sowb. A beautiful species; the surface is closely set with spiral lines and the longitudinal costæ are small and numerous. The columella is of a bright red. A common form.

182. **Strombus (Canarium) gibberulus,** Linn.

183. " " **Samar,** (Chemn.) Dillw.

184. " **(Conomurex) mauritianus,** Lam.

This last is a very common and a very characteristic species of the region ; it is very closely allied to *Strombus luhuanus*, Lin.; but is at once distinguished by the black deposit on the columella.

185. **Pterocera (Millipes) violacea,** Swains.

186. " " **elongata,** Swains.

187. " **(Harpago) rugosa,** Sowb.

The above three species were represented by a number of individuals.

Family CERITHIIDÆ.

188. **Cerithium nodulosum,** Brug.

189. " **echinatum,** Lam.

190. " **(Vertagus) asper,** Linn.

191. " " **obeliscus,** Brug. The smaller form called by Sowerby *cedo-nulli*.

192. **Cerithium (Vertagus) Kochii,** Phil. Said to be quite rare.

Family LITORINIDÆ.

193. **Litorina (Melaraphe) scabra,** Linn. A very common species of wide distribution.

Family CALYPTRÆIDÆ.

194. **Mitrularia tectum-Sinense,** Lam.

Family XENOPHORIDÆ.

195. **Xenophora caperata,** Phil.

Family NATICIDÆ.

196. **Natica marochiensis,** Gmelin. Very common. This species, with its varieties, is found in almost every quarter of the globe.

197. **Natica (Mamma) mamilla,** Linn.

198. **Natica (Mamilla) melanostoma,** Gmelin.

199. " " **maura,** Brug.

200. **Sigaretus planulatus,** Recl.

Family LAMELLARIIDÆ.

201. **Lamellaria (Chelynotus) Berghi,** Desh. A common form.

Family NERITIDÆ.

202. **Nerita albicilla,** Linn. Numerous specimens received.

203. **Nerita (Odontostoma) polita,** Linn. The specimens from the Mauritius are of a uniform gray, mottled with black, and do not seem to vary to any extent.

204. **Neritina gagates,** Lam. Quite a variable species and one very common to the region.

205. **Neritina (Clithon) longispina,** Recluz.

206. " " " var. **mauritiana,** Morelet.

The variety is often twice the size of the typical form and destitute of spines, or at least with an occasional single spine on the shoulder. Very common.

207. **Neritina (Alina) mauritii,** Lesson. Quite well known under the name of *sandwichiensis*, Desh., which is a synonym. Only three specimens received.

208. **Septaria (Elara) suborbicularis,** Sowb.

Family NERITOPSIDÆ.

209. **Neritopsis radula,** Linn. Not uncommon.

Family TURBINIDÆ.

210. **Turbo petholatus,** Linn. The specimens before me are much darker than is usual with this species and are highly polished.

211. **Turbo Japonicus,** Reeve. This shell was described as from Japan, but Sowerby says it is from the Mauritius only. I have never seen one from Japan but have seen numerous specimens from the Island of Mauritius.

212. **Turbo argyrostomus,** Linn.

213. **Turbo setosus,** Gmelin. Both of the above forms were received in considerable numbers.

214. **Tubo radiatus,** Gmel.

Family TROCHIDÆ.

215. **Trochus (Cardinalia) virgatus,** Gmel. Does not seem to be common.

Family HALIOTIDÆ.

216. **Haliotis pustulata,** Reeve. A very variable species received in considerable quantity, and allied to *H. varia*, Linn., but separated from that species by the flattened cords of the surface.

Family FISSURELLIDÆ.

217. **Glyphis Rüppellii,** Sowb. A very common species.

Order POLYPLACOPHORA.

Family CHITONIDÆ.

218. **Acanthopleura borbonica,** Desh. A very common species, very like *Chiton piceus*, Gmelin, from the West Indies.

219. **Chiton** sp. A small species which I was not able to identify.

Class PELECYPODA.

Family OSTREIDÆ.

220. **Ostrea** sp. Small specimens, evidently young individuals, found attached to floating pieces of pumice stone.

Family SPONDYLIDÆ.

221. **Spondylus coccineus,** Lam. Very common.

Family PECTINIDÆ.

222. **Pedum spondyloideum,** Gmelin. Not a common species.

Family AVICULIDÆ.

223. **Avicula (Meleagrina) margaritifera,** Linn.

A number of fine, handsome specimens were in this collection.

224. **Avicula (Meleagrina) Martensi,** Dkr.

A very common form.

225. **Vulsella (Madrela) spongiarum,** Lam.

A number of this form were contained in the collection imbedded in a sponge.

226. **Perna ephippium,** Linn. Judging from the scarcity of this species in collections from the Mauritius, this form must be quite rare at that locality.

Family MYTILIDÆ.

227. **Modiola** sp. A small form which I was not able to satisfactorily identify.

Family ARCIDÆ.

228. **Arca revelata,** Desh.

229. " **(Barbartia) velata,** Sowb.

Neither of the above forms seem to be at all common, judging from the number received.

Family CARDIIDÆ.

230. **Cardium (Trachycardium) mauritianum,** Desh.

231. " " **bicolor,** Sowb.

232. " " sp.

233. " **(Papyridea) papyracea,** Chemn.

All the above more or less common.

Family CYPRINIDÆ.

234. **Libitina guinaica,** Lam.

235. " **angulata,** Lam. Not common.

Family LUCINIDÆ.

236. **Lucina tigrina**, ? Linn. I am not certain that this is the same as our West Indian *tigrina*, but the characters are so nearly alike, that if the two forms were mixed, it would be impossible to separate them.

237. **Lucina** sp. A small form which I was not able to identify.

Family VENERIDÆ.

238. **Meretrix (Lioconcha) tigrina**, Lam. A species of great variation of color pattern.

239. **Meretrix (Pitar) læta**, Linn.

240. **Circe (Crista) pectinata**, Linn.

241. **Dosinia variegata**, Gray. A small species, apparently very common.

242. **Venus (Chione) toreuma**, Gould.

243. " " **Listeri**, Gray.

244. **Tapes litterata**, Linn.

All the above species were well represented in the collection by a number of individuals.

Family DONACIDÆ.

245. **Donax abbreviatus**, ? Lam.

246. " sp. Both common.

Family TELLINIDÆ.

247. **Tellina (Tellinella) rugosa**, Born.

248. " " **virgata**, Linn.

249. " **(Liotellina) radiata**, Linn.

250. " **(Acropagia) scobinata**, Linn.

The above four forms were received in moderate quantity; the Tellinas do not seem to be abundant at the locality where these were obtained.

Family SEMELIDÆ.

251. **Semele borbonica**, Desh. Quite rare.

Revision of the genus Magilus of Montfort.

The genus Magilus has been somewhat of a puzzle, in many respects, to Conchologists, and from its varying habits and the paucity of material at the disposition of the student many errors in description have arisen. In the collection of shells dwelt upon in the first part of this paper, was a suite of over a hundred Magili in all stages of development from the very young shell, so thin and fragile that it seemed as though a breath would break it, to the adult animal with a heavy tube over a foot in length. From this collection and from a number of specimens in my own collection, I have drawn up the following notes :

Messrs. H. and A. Adams, in their "Genera of Recent Mollusca," following Rüppell, distinguished the genus Leptoconchus from Magilus, the differential characters being that Magilus formed a tube and possessed an operculum while Leptoconchus did not ; many of the full grown specimens of *Magilus antiquus* before me are strongly suggestive of some of the species included by these authors in Leptoconchus. However, should this character of the absence of operculum prove constant, after the examination of a large quantity of fresh material, the two genera should by all means be separated.

Dr. Paul Fischer, in his Manuel de Conchyliologie, p. 648, separates the two genera on account of the absence of the operculum in Leptoconchus, but acknowledges the difficulty of affixing the generic value.

The animal of Leptoconchus is described as having a greatly thickened and fleshy mantle margin ; tentacles small, broad and united at their bases ; eyes small and black, on the outer side of the tentacles, near their tips ; foot small, short, obtuse and rounded behind, with a thin, expanded disc-like lobe in front ; the siphon is obsolete. Of four individuals examined by Rüppell two were males and two females. The males were characterized by the presence of a straight, acuminate verge, swollen and club-shaped at the extremity, placed on the right side of the body. The presence of such an organ in a fixed animal is very extraordinary and requires further investigation.

Troschel was unable to discover any indication of armature upon the lingual ribbon ; but this fact might be accounted for by their sedentary habits, which would do away with the need of such an organ, as their food must necessarily be brought to them by the currents ; and as they are attached, their food must be of a small, almost microscopic character, as active animals could easily escape them, and so the radula would gradually become reduced to a rudiment through disuse, although the ancestral form might have possessed a very complicated lingual apparatus.

The Magili are so irregular in their growth that other than purely conchological characters must be used for their certain identification, and, while the shells possess some very good characters, I believe that the animal and operculum should be given an equal place in the diagnostic characters.

In the following notes I shall endeavor to establish the synonomy as well as my material, which is unusually abundant, will permit, but until the anatomy of all the forms is thoroughly worked out and their life history studied we cannot hope for anything more than a provisional classification.

Genus MAGILUS, Montfort.

Conch. Syst., 43, 1810.

Campulotus, Guettard, (part) Mém. 3, 540, 1786.

In this genus the animal becomes fixed to some coral (*Meandrina*) and in the adult stage forms a tube and possesses an operculum.

Magilus antiquus, Lam. Pl. 9, f. 1, 2, 3.

An. sans Vert., 2d edition, V, 639.

Magilus costatus, Sowb., Conch. Icon., sp. 5, 1872.

Campulotus Cumingii, H. and A. Ad., Zool. Proc., 430, 1863.

Magilus Cuvieri, Desh., Conch., Réunion, 128, t. 13, f. 6, 7.

Magilus Djedah, Chenu, Ill. Conch., t. 1, f. 3, 4.

Magilus ellipticus, Sowb., Genera, No. 21.

Magilus microcephalus Sowb., Conch. Icon., sp. 3, 1872.

Leptoconchus oblongus, Sowb., H. and A. Adams, Genera 1, 138.

Leptoconchus Peroni, Lam., An. sans Vert., 2d edition, t. 5, p. 639.

Leptoconchus rostratus, A. Ad., Ann. Mag. N. H., 3d ser., XIII, 310, 1864.

Magilus Rüppellii, Desh., Zool. Proc., 105, 1843.

Leptoconchus Schrenkii, Lischke, Mal. Blatt., XVIII, 40, 1871; Jap. Moll., Sup., 45, t. 4, f. 9, 10.

Magilus serratus, Desh., Sowb. in Conch. Icon., sp. 8, 1872.

Leptoconchus serratus, Rüppell, A. Adams, Ann. Mag. N. H., 3d ser., XIII, 310, 1864.

Magilus striatus, Rüppell, Trans. Zool. Soc., 1, 259, t. 35, f. 9, 10.

Magilus tenuis, Chenu. Ill. Conch., t. 1, f. 8 a.

I have before me seventy specimens of this species in every degree of growth from young to adult, so that I am able to place in the synonomy several species which, from the published figures, seem quite distinct. The *M. costatus* of Sowerby I am able to connect with *antiquus* through a very extensive set of specimens which shows that the ribs, on which the species is founded, are but pronounced examples of the spiral striæ so characteristic of *antiquus*.

One very young form before me is smooth, and very much like *Rapa papyracea* in form. The young shells show a great variety in sculpture, from almost smooth, to a wonderful degree of scabrosity. As the shell gets older and prepares to settle down, it thickens the aperture, and the lines of growth become thicker and more crowded together ; as it forms its tube it widens the aperture and starts a keel from the base of the columella, which is persistent throughout the life of the animal. The tubes are often twisted into many different shapes, some twisting in a cork-screw-like manner and others simply bending or curving ; still others are nearly straight.

Many of the larger tubes are quite heavy and one now before me must weigh nearly a pound, and measures ten inches in length, although somewhat curved, and would measure a foot if straightened out.

One of the specimens fortunately contained the operculum ; this is oval, concentrically laminated, twelve mill. in length and six in width ; the nucleus is lateral. It is much too small for the aperture of the tube, and would seem to be of but little use to the animal.

M. Rüppellii, (pl. 8, f. 5) Desh., may be retained as a variety characterized by a narrower shell and longer aperture.

Genus LEPTOCONCHUS, Rüppell.

In this genus the adult does not (is not known to) form a tube and there is no operculum ; otherwise the animal resembles that of Magilus.

Leptoconchus Cumingii, Desh., Pl. 9, f. 4, 6. Conch. Ile Réunion, 125, t. 12, f. 340, 1863.

Magilus antiquus, Sowb., Conch. Icon., f. 1 b.

Magilus globulosus, Desh., Sowb. in Conch. Icon., sp. 10, 1872.

I have before me ten specimens which seem to represent this species. *Cumingii* is a more elongate, less rounded shell than *Magilus antiquus;* the spire is more or less conical and the whole shell is bullet shaped, or like a minie-ball; the longitudinal sculpture consists of close set lines of growth which are raised into scales at the suture. The aperture is about as long as the spire, oblong-oval in outline, well rounded below and a little pointed above; the columella is rounded, smooth and covered with a heavy, wide-spreading callus.

Some specimens of *Magilus antiquus*, with a tube just started, are strongly suggestive of this species, in the somewhat raised spire. It is difficult, however, to decide whether this is a deflection due to the formation of the tube or is a true *Cumingii.*

Leptoconchus Maillardi, Desh. Pl. 9, f. 7. Conch. Ile Réunion, p. 217.

Magilus Lamarckii, Desh., Conch. Ile Réunion, p. 127 t. 12, f. 1-3.

Magilus solidiuscula, Pease, Sowb. in Conch. Icon., sp 12, 1872.

This species has a pointed spire and aperture and is in a general way spindle shaped. The aperture is long and pointed and about twice the length of the spire; the sculpture consists of longitudinal growth lines, close set and slightly raised into scales at the sutures; the spiral sculpture consists of heavy, squamose liræ with interstices of the same width as the liræ between them; the columellar is rounded and covered with a spreading callus.

I have before me over a dozen specimens of this species and I have no difficulty in separating them at once from any of the related species. In none of the specimens examined have I seen anything approaching the formation of a tube as in Magilus.

Mr. Arthur L. White read a paper entitled:

A DISCUSSION OF THE RECENT EXPERIMENTS ON THE ARTIFICIAL PRODUCTION OF RAIN.

The paper was illustrated by blackboard diagrams, maps and an air pump.

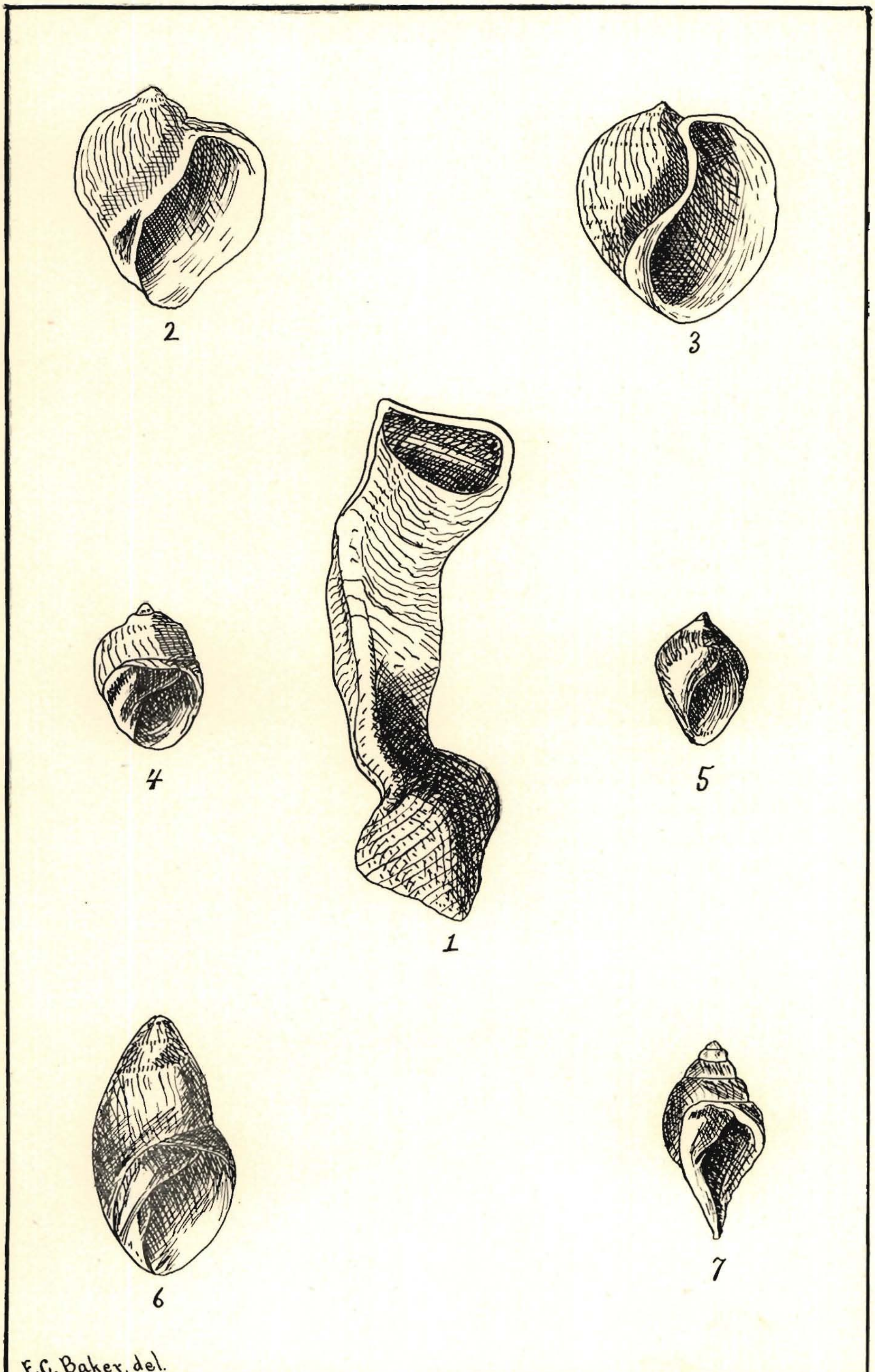
Dr. M. A. Veeder, Mr. Menzo Van Voorhis, the President and others participated in the discussion of the paper.

PLATE 9.

Revision of the Genus Magilus, &c.

1. Magilus antiquus, Lam. Adult form with tube.
2. " antiquus, Lam. Juvenile.
3. " antiquus, Lam. Juvenile. A more rounded form than number 2.
4. Leptoconchus Cumingii, Desh. A depressed form.
5. Magilus antiquus, Lam, var. Rüppellii, Desh.
6. Leptoconchus Cumingii, Desh. Typical form.
7. Leptoconchus Maillardi, Desh.

ALL THE FIGURES ARE NATURAL SIZE.



BAKER—REVISION OF THE GENUS MAGILUS, ETC.

DECEMBER 14, 1891.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Thirteen persons present.

The Council report recommended :

(1.) The election of the following candidates as resident members.

MRS GEORGE KING,
SERG'T ARTHUR L. WHITE,
MR. C C. LANEY,
MRS. KATHERYN C. MAHON,
MR. GEORGE M. ELLWOOD.

(2.) The payment of certain bills.

(3.) That the Council be authorized to employ a clerk at a salary not to exceed one hundred dollars per annum.

The candidates were elected by a formal ballot, the bills ordered paid and the Council authorized to employ a clerk.

The Council also reported the formation of a committee on entertainment for the reception of the American Microscopical Society in August, as follows :

Chairman, DR. M. L. MALLORY,

CHARLES E. ALLING,
ED. BAUSCH,
A. M. DUMOND,
PROFESSOR S. A. ELLIS,
PROFESSOR S. A. LATTIMORE,
J. EDWARD LINE,
GEORGE W. RAFTER,
J. EUGENE WHITNEY,
DR. J. L. ROSEBOOM,
DR. CHARLES R. SUMNER,
J. M. DAVISON,
ED. E. BAUSCH,
GEORGE R. BAUSCH,
GEORGE W. GOLER,
CARL LOMB,
HENRY LOMB,
RUDOLPH SCHMIDT,
WILLIAM STREETER,

PROFESSOR Z. F. WESTERVELT.

The Secretary, MR. FRANK C. BAKER, gave a lecture on

THE DIGESTIVE SYSTEM OF THE MOLLUSCA.

The subject was illustrated by charts and diagrams.

JANUARY 11, 1892.

THIRTEENTH ANNUAL MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Thirty-one persons present.

The Council report recommended the election of the following candidates as resident members :

DR. P. MAX FOSHAY,
MISS GEORGIANA C. STONE,
MR. ARTHUR R. SELDEN.

The candidates were elected by formal ballot.

The annual reports of the officers and sections were presented.

SECRETARY'S REPORT.

The report of the Secretary, MR. FRANK C. BAKER, is summarized as follows :

During the past year seventeen meetings have been held, at which the average attendance has been fifty-three.

Twenty resident members and one honorary member have been elected and six resignations have been accepted. Six members have been made fellows.

Nineteen papers have been read and six lectures have been given before the Academy during the year. The papers are classified as follows :—Zoölogy five ; Geology and Mineralogy, each three ; Archæology and Botany, each two ; Chemistry, Astronomy, Meteorology and Photography, each one Of the six lectures three were on Geology, two on Geography and one on Zoölogy.

Two valuable collections have been added to the Cabinet of the Academy this year. PROF. A. L. AREY presented a complete set of specimens illustrating the local Palæontology. MR. JOHN WALTON has given a collection of shells representing the Molluscan fauna of Monroe County.

LIBRARIAN'S REPORT.

The following is an abstract of the report of the Librarian, Miss Mary E. Macauley:

Number of bound volumes received during 1891	20
Number of pamphlets	590
Total accessions for the year	610
Whole number of bound volumes in library	82
Whole number of pamphlets	939
Total	1021

Many of the accessions have been the transactions of societies, and these contain many exceedingly valuable papers. Noteworthy additions have also been received from the Smithsonian Institute, the Department of Agriculture and the New York State Museum.

TREASURER'S REPORT.

The Treasurer, Mr. E. E. Howell, having removed to Washington during the year, no report was made at the annual meeting, but subsequently a report was sent, of which the following is a summary:

Receipts.

Balance from 1890	$ 73.85	
From initiation fees and annual dues	287.00	
From interest	6.28	
Total		$367.13

Expenditures.

Notice of meetings, stationery, postage and various incidental expenses	$167.11	
*Illustrations for proceedings (Brochure 2)	31.50	
Author's reprints of papers	24.00	
Total		$222.61
Balance in treasury		$144.52

* It may be of some interest to state the total cost of Brochure 2 of the first volume of Proceedings, most of which has been paid since the annual meeting. The cost of printing was $204.97; of illustrations, $31.50; and of author's reprints, $24.00; total $260.47. [Ed.]

REPORT OF THE SECTION OF BOTANY.

Read by MRS. J. H. McGUIRE, Recorder of the Section.

The officers of the Section are: Miss Mary E. Macauley, President; Miss Florence Beckwith, Vice-President; Mrs. J. H. McGuire, Recorder.

Extracts from the Minutes of the Section.

January 16, 1891. Microscopical studies. Mr. Streeter exhibited the streaming of protoplasm in the cells of the Onion. The cyclosis was very well marked. He also exhibited the fibro-vascular bundle in Bryony and a section of Pteris, showing fibro-vascular bundle in underground stem and also the scalariform and sieve tissues; intercellular spaces of leaf-stalk of Water-lily and Rush; epidermis of Narcissus; epidermis of Cabbage; sections of Cedar showing the pitted vessels and the medullary rays.

February 13, 1891. Mr. Dumond exhibited a growing plant of Dandelion with blossoms and fruit. The plant was found in a crevice of a brick wall. The microscopical studies were: soft tissue of pith of Elder; thick-angled tissue of flowering stalk of Rose; stony tissue of Black Walnut; bast and wood fibre; tissue of Soft Maple, showing bordered pits; bast tissue of *Abutilon;* milk tissue of Salsify root, showing starch grains; and sieve tissue of Pumpkin stem.

February 27, 1891. Mr. Dumond showed stomata of Oleander in which the guard cells were found in a depression which extended into the palisade tissue. The depression was lined with hairs, completely concealing the stomata which could only be seen in a cross section. Bone shaped starch granules were shown in Euphorbia. Specimens of *Jungermannia reptans*, *J. trichophylla*, *J. curvifolia* and *Sphagnum cymbifolium*, found in Bergen by Mr. Booth, and mounted by him, were exhibited. Miss Beckwith exhibited *Poa annua*, and reported Chickweed in blossom February 24.

March 27, 1891. Mr. Dumond exhibited two specimens of *Protococcus nivalis*, cultivated by him under varying conditions. One specimen was grown in Hemlock Lake water, the other in water from ice. The latter showed a much more abundant growth than the former. Mr. Dumond also exhibited *Batrachospermum monilliforme.*

Mr. Streeter exhibited a specimen of Alga, having some resemblance to water-flannel. It was reserved for future study. Miss Beckwith reported Chickweed in blossom March 12.

April 10, 1891. A specimen of Tetraspora was examined. The characteristic division by fours was well defined. Other microscopical studies were, epidermis of Century plant, showing needle-shaped crystals and the parenchyma tissue; section of petiole of Verbena showing fibro-vascular bundles; *Drapernaldia glomerata.*

April 10, 1891. Mr. Streeter reported results of study of *Ulothrix zonata.* He had secured a specimen which had completed the stage of conjugation, and was growing vigorously. It had millions of Euglena, which again developed into the resting condition of Protococcus. These changes seemed to him to be identical with the processes of growth of *Batrachospermum monilliforme*, *Drapernaldia glomerata*, *Spirogyra* and others. These observations suggest the idea of a common origin.

April 24, 1891. A large number of spring blossoms shown by members of the Section. Among the microscopical studies was a fine specimen of Peziza. The spore sacs were well defined. The Alga resembling water flannel, referred from a former meeting, and now in a more advanced stage of growth was pronounced to be *Ulothrix zonata.*

May 8, 1891. A fine specimen of Jeffersonia found by Mr. Walton near Pittsford, was exhibited.

Among other spring flowers, five varieties of violet were exhibited, viz: *V. palmata*, *V. cucullata*, *V. blanda*, *V. rostrata*, *V. pubescens.*

A stipe was shown upon which a large number of diatoms were growing.

May 22, 1891. Miss Macauley showed *Floerkia proserpinacoides* found near Fairport, and never before brought to the Section.

May 29, 1891. Miss Beckwith exhibited leaf of Jeffersonia, measuring 6 inches by 4 inches, *Viola palmata*, *V. hastata*, *V. rostrata*, *V. cucullata*, *Camelina sativa*, *Cypripedium pubescens.*

Mr. Dumond exhibited an abnormal plant, destitute of chlorophyll, although growing from a corm, and having roots. Two leaves were developed and a third was partially grown. No one recognized the plant, and its lack of color was the subject of various conjectures.

June 24, 1891. A number of plants found at Bergen were examined, the Section having made a recent excursion to that place. They were: *Cypripedium pubescens*, *C. spectabile*, *Habenaria dilatata*, *Pogonia ophioglossoides*, *Triglochin maritima*, *Linnæa borealis*, *Galium boreale*, *Mitchella repens*, *Vaccinium oxycoccus*, *Cornus Canadensis*, *Diervilla trifida*, *Iris versicolor*, *Sarracenia purpurea*, *Acer spicatum*, *Ariophorum polystachum*, *Chætophora endibiæfolio*, *Batrachospermum monilliforme*.

July 3, 1891. Miss Macauley exhibited *Crepis biennis*, recently introduced and found near Fairport. Miss Macauley also exhibited the following plants from Watkins Glen: *Gillenia trifoliata*, *Rosa lucida*, *Asclepias tuberosa*, *A. cornuti*, *Lysimachia quadrifolia*, *Kalmia latifolia*, *Galium boreale*, *Trifolium agrarium*, *Leonurus cardiaca*, *Castanea sativa*, *Pentstemon pubescens*, *Habenaria dilatata*, *Cypripedium spectabile*.

Dr. Searing exhibited *Ophioglossum vulgatum*, which she had found at Long Pond. This plant has only once before been reported from Monroe County.

Dr. Searing also showed *Elodes campanulata*, *Agaricus cassanus*, *Russula pubescens*, and *Hygrophorus caraphellus*.

July 17, 1891. *Nasturtium sylvestre* was exhibited and reported growing in some abundance on the river road, near Genesee Valley Park. This plant has rarely been found in this locality and its advent was the subject of some discussion. A new station for *Poterium Canadense* in the southwestern part of Monroe County was reported and specimen of the plant exhibited. Also a new station for *Calopogon pulchellus* west of Fairport was reported and specimen exhibited. *Myosotis palustris* was also shown.

July 31, 1891. Miss Macauley exhibited *Asclepias verticillata* and also *Polanisia graveolens* neither of which were before seen in the class.

Miss Beckwith showed a unique specimen of *Rudbeckia hirta* with a dark-colored band around the petals, which gave it some resemblance to Coreopsis.

Aug. 7, 1791. The death of Mr. Edward Walker, a member of the Section was announced and a committee appointed to draft suitable resolutions to report at the next meeting.

Dr. Searing exhibited *Russula rubra*. She also showed *Ammonita pelloides* in four stages of growth. Dr. Searing gave a very instructive talk on the life history of this fungus, illustrating her subject by these specimens.

August 21, 1891. Miss Macauley stated that she had received a communication from Mr. Hankinson, in which he offered to furnish plants which were lacking to complete the herbarium of the Section. Miss Macauley exhibited two growing plants of *Goodyera pubescens* found in the glen near Canandaigua.

September 4, 1891. Dr. Searing exhibited *Solidago rigida.*

Miss Macauley exhibited *Lycopodium dendroidum* in fruit, branches of *Gaylussacia resinosa*, *Andromeda polifolia*, *Cassandra calyculata* from Mendon.

September 18, 1891. Miss Beckwith exhibited *Arctostaphylos Uva-ursi* from near Mumford ; this is rarely found so far south, and never before reported in this section. *Gentiana crinita* and *G. quinque-flora* were also shown.

October 23, 1891. Miss Beckwith exhibited *Amarantus blitoides* newly introduced from the West. The latest edition of Gray's Botany reports it as only reaching east as far as western New York.

November 6, 1891. Mr. Streeter illustrated the process of Abscissa with branch and leaves of Horse-chestnut.

Miss Beckwith showed *Linaria Canadensis*, not before seen in the Section, and fruit of *Nemopanthes fascicularis.*

The Curator, Miss Beckwith, reported that 200 specimens of plants had been sent to the Melbourne Botanical Gardens in return for a collection of Australian plants sent from that Society to the Section. Microscopical Studies : Spirogyra, Vaucheria, Lenma, Euglena, Red Protococcus, Nitzschia tenuis, Closterium, and the circulation of protoplasm in Vallisneria.

November 20, 1891. The evening was devoted to the study of Mosses. Dr. Searing described the life history of the genus Hypnum from spore to fruitage, illustrating her subject with drawings and pressed specimens of the different species.

December 4, 1891. Miss Beckwith exhibited a growing plant of *Goodyera pubescens* in fruit, found at Ithaca by Warner W. Gilbert. This exhibit is worthy of special mention, as the plant is rarely seen in blossom or fruit.

A collection of 75 pressed specimens of native Syrian plants was received from Mr. Joseph B. Fuller. The Secretary was instructed to return a suitable acknowledgment of the generous gift to the Section.

December 18, 1891. *Ilex verticillata*, from Seneca Park and *I. lævigata* from River Road were shown.

The study of Acorns was continued from the last meeting. Seven species were reported found in this locality.

Mr. Laney exhibited a large number of leaves of indigenous shrubs and trees.

Miss Beckwith exhibited a fine growing plant of *Camptosorus rhuophyllus* and *Asplenium Trichomanes* sent from Ithaca by W. W. Gilbert, also a specimen of *Usnea barbata*.

January 8, 1892. Microscopical studies: Dr. Searing exhibited *Azolla Caroliniana*, and also papillose leaf of *Hypnum delicatulum*.

Miss Beckwith reported Dandelion in blossom December 14, Chickweed January 1, and Golden-rod in November.

The Curator of Botany, MISS BECKWITH, reported as follows:

Number of mounted specimens in the herbarium	1873
Number of unmounted specimens	700
Total	2573

This includes a collection of nearly 200 Australian plants, a collection of Colorado plants given to the Academy by MISS M. E. MACAULEY, a collection containing about 75 Syrian plants recently donated by MR. JOSEPH B. FULLER, and a collection of Hawaiian ferns given by MRS. FREDERIC S. WEBSTER.

REPORT OF THE SECTION OF GEOLOGY.

The Report of the Section of Geology was read by the Recorder of the Section, Mr. H. L. Preston.

ELECTION OF OFFICERS.

The election of officers for the ensuing year was held, and resulted as follows:

President, H. L. FAIRCHILD.
First Vice-President, A. L. AREY.
Second Vice-President, J. EDW. LINE.
Secretary, FRANK C. BAKER.
Corresponding Secretary, CHARLES W. DODGE.
Treasurer, J. EUGENE WHITNEY.
Librarian, MARY E. MACAULEY.
Councillors, WILLIAM STREETER. HENRY A. WARD.

The following paper was accepted for publication by the Council and read by title :

THE THICKNESS OF THE DEVONIAN AND SILURIAN ROCKS OF WESTERN NEW YORK ; APPROXIMATELY ALONG THE LINE OF THE GENESEE RIVER.

BY CHARLES S. PROSSER.

CONTENTS :

INTRODUCTION.

The October number of the American Geologist for 1890 (1) contained an article on "the thickness of the Devonian and the Silurian rocks of Western Central New York." The present paper is a continuation of that general investigation, and the section crosses western New York somewhat west of the Genesee river. The series of terranes composing this section is identical with that discussed by Prof. Henry S. Williams, in his Bulletin on "The Genesee Section, New York," (2) together with those of the Lower Devonian and Silurian. Many of the well sections described in this paper are near localities at which Professor Williams has described outcrop sections

(1.) *Op. cit.*, vol. vi, pp. 199–211.

(2.) Bull. U. S. Geol. Surv., No. 41 : On the Fossil Faunas of the Upper Devonian—The Genesee Section, New York, 1887.

in the Bulletin just mentioned, consequently it does not seem inappropriate to designate it the Genesee Section.

The section crosses Allegany, Wyoming, Genesee and Monroe Counties, and is in the main compiled from the records of wells near Richburgh and Clarksville, Allegany Co., Castile and the Warsaw salt region of Wyoming Co., LeRoy and Batavia, Genesee Co., and Brockport and Rochester, Monroe Co. Geologically the section commences with the Olean conglomerate and its equivalents, which occur at or near the summit of the highest hills in southern Allegany and Cattaraugus Counties, New York, and in northern McKean County, Pennsylvania. Then it crosses New York State, passing through the several terranes composing the Devonian and Silurian systems, and terminates probably with the top of the Archean as shown by the record of the Rochester well.

The Genesee Section.

In reviewing the history of the geology of western New York, there seems to be special reason for carefully describing this section.

In 1838 Professor James Hall, at that time State Geologist of the Fourth District of New York, published a geological "Section from the mouth of the Genesee River to Instantur, Penn." (1) Among the towns touched by this section are Rochester, Caledonia, Mt. Morris, Portage, Angelica and Wellsville, N. Y., thence through Coudersport and Smithport to Instantur. It will be noticed immediately that in a general way the New York part of this section follows quite closely the direction of the one outlined for this paper. It is interesting to note briefly the correlations made on this section and in the accompanying description. The author says: "I consider the rocks of the 4th District as belonging to the old red sandstone and the carboniferous groups, and to be above the Silurian system of Mr. Murchison." (2)

The Medina red sandstone was considered as belonging to the "Old Red Sandstone." The next general correlation is that of the Upper Helderberg or Corniferous, which is called Carboniferous or Mountain limestone. (3) The remainder of the section is included

(1.) 2d Ann. Rept. Fourth Geol. Dist., N. Y.

(2.) *Ibid.*, p. 291.

(3.) *Ibid.*, p. 292, where it is stated that "Upon the Gypseous [Onondaga Salt group or Salina] rocks lies the mountain limestone, commencing at Caledonia and near West Mendon, and extending as far south as Avon." While on the section between Caledonia and York it is given as "Carboniferous or Mountain Limestone." Also see foot note on p. 302 and p. 307.

in the Carboniferous and the first coal was noted at Instantur, Penn.

The above correlation apparently did not consider the previous statement of Conrad, that the red sandstone on the Niagara and Genesee rivers "has been referred by some geologists to the New, by others to the Old red sandstone of Europe, with neither of which does it bear the remotest analogy in the contained organic remains, or in its relation to other rocks. Indeed it is far below the strata which Mr. Richard C. Taylor, with great appearance of probability, refers to the old red sandstone, and which are wanting in the third district [this part of the third district formed the northern portion of the fourth district in the following reports]." ([1])

In the report of 1839 there was no direct reference to the correlation of the preceding report; but several local names were proposed. ([2])

The report for 1840 shows it had been decided that the thin layers of red sandstone and shale in Allegany Co., were stratigraphical equivalents of the rocks near Tioga, Penn., which had been referred by Mr. Taylor to the "Old Red Sandstone." Professor Hall wrote: "In tracing this rock westward, [from Tioga] we find it bordering the southern limits of the State, and in Allegany Co. extending north of the line." ([3]) "I have not yet identified it beyond [west of] the Genesee. At this place near the mouth of Dyke Creek, at Wellsville, it contains fragments of bones resembling those at Tioga." * * * *

"This rock forms the limit between the Silurian and Carboniferous systems and may be regarded as one of the most important of the whole series." ([4]) While in the final report Professor Hall said: "At Wellsville, * * * * the rocks of this group [Chemung] terminate, and are succeeded by some thin ferruginous strata of the Old Red sandstone, and this again by grey diagonally laminated sandstone and conglomerate." ([5])

In 1838 Professor Dewey stated that the dip "along the Genesee river is one foot in eighty to one hundred feet. If we call it only one in a hundred, in fifty miles, which is less than the distance to the southern boundary of the State, the dip would place the rocks two

(1.) 1st Ann. Rept. Third Geol. Dist., N. Y., 1837, p. 167.

(2.) 3d Ann. Rept. Fourth Geol. Dist., N. Y., where it is stated on p. 288 "With regard to the arrangement and succession of rocks presented in the section accompanying the report of last year, I have no important alterations to suggest."

(3.) 4th Ann. Rept. Fourth Geol. Dist., N. Y., p. 393.

(4.) *Ibid.*, p. 394.

(5.) Geol. N. Y., Pt. IV, 1843, p. 250. In connection with this see Prof. H. S. Williams' description of a quarry at Wellsville, in Bull. U. S. Geol. Surv., No. 41, pp. 77, 78.

thousand six hundred and forty feet or half a mile below their relative situation near Lake Ontario." ([1]) The red Medina of the Genesee Falls was correlated with "the *old red sandstone* of European geologists." While it was further stated: "On this sandstone rests a series of slates, limestones, shales, and siliceous strata, which corresponds perfectly to the mountain limestone of Europe." ([2])

For a continuation of the history of the correlation of these terranes, bringing the classification into harmony with that of the present, the reader is referred to the excellent presentation of the subject in the correlation paper of Professor H. S. Williams on the Devonian and Carboniferous. ([3])

CORRELATION OF THE UPPER DEVONIAN AND LOWER CARBONIFEROUS.

The first well record to be considered is that of one situated between Richburgh and Clarksville, Allegany Co.; but before giving this record it is necessary to hastily review the geological position of the Olean conglomerate and underlying rocks. The opinions of the geologists who have recently studied this series of rocks most thoroughly—Ashburner, Carll and H. S. Williams—are not in complete harmony as to their geological age, therefore it is necessary to state briefly the different correlations and to indicate which is followed in this paper.

Ashburner in 1880 published the following section of the rocks of McKean County, Penn.: ([4])

Base of the
Pottsville conglomerate, No. XII—Olean conglomerate
Mauch Chunk, No. XI—Cannel slate............10′ ([5])

Pocono, No. X,	Upper—Shales and sandstones..	60′	250′ ([6])
	Middle—Sub-Olean conglomerate	40′	
	Lower—Shales and sandstones...	150′	

(1.) Am. Jour. Science, 1st ser., vol. xxxiii, p. 121.

(2.) *Ibid.*, p. 122.

(3.) Bull. U. S. Geol. Surv., No. 80, in particular Chapters I and II.

(4.) Report R, 2d Geol. Surv. Penn. The Geology of McKean Co. See the "vertical section" on p. 43 and the detailed account of the following part of the section from p. 56 to p. 76. Also, a paper by the same author on "The Bradford oil district of Pennsylvania," in Trans. Am. Inst. Min. Eng., vol. vii, p. 316-328, and especially pp. 320, 321.

(5.) *Ibid.*, p. 64. "Generally throughout central and northern McKean the Mauch Chunk formation is represented by 5 to 10 feet of ferruginous argillaceous shale or black slate, sometimes containing cannelly layers or a thin slaty coal, (*Marshburg lower coal.*)"

(6.) *Ibid.*, p. 65. "The thickness of the entire group varies; at Bradford it is 247 feet."

Catskill, No. IX	Red and gray shale and sandstone	250′	
Upper Chemung, No. VIII.	Gray shale and sandstone	350′	1300′ (1)
	Red and gray shale and sandstone Mansfield red beds	300′	
	Gray shale and sandstone	650′	
Middle Chemung	Bradford oil sandstone	45′	
Lower Chemung, No. VIII	Gray shale and sandstone	645′+	

In 1887 Ashburner first published his correlation of the Richburgh oil and gas sand of Allegany Co., N. Y., with that of the Bradford. He said: "According to Mr. Carll this sand [the oil-sand of Allegany district] lies about 150 feet below the Clarendon Third sand. From my own examinations, made in both the Allegany and Bradford oil districts and across the intervening country, I was disposed to regard this sand as identical with the Bradford, which lies between 300 and 400 feet below the Clarendon Third sand." (2) In 1888 this opinion is stated positively, as follows: "The geological horizon of the Allegany oil and gas-sand which is commonly and locally known as the Richburgh is the same as that of the main producing oil and gas-sands of the Bradford region, known by the oil-well drillers as the Bradford third sand." (3) Also, "It may be accepted as beyond question that the productive oil and gas-sands in the vicinity of Richburgh, Bolivar, Allentown, the Waugh and Porter well and at Bradford are geologically the same, although they differ much in their physical characteristics." (4)

Mr. John F. Carll, who has carefully studied the conglomerates of southwestern New York and northwestern Pennsylvania, mentioned in 1887 an outlier of the Olean conglomerate "near the center of Genesee township, Allegany County, [N. Y.]" at an altitude of "about 800′ above little Genesee creek and 2350′ above ocean." (5) In this report Mr. Carll gave a generalized section for 800′ of the rocks below

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(1.) *Ibid.*, p. 73. "The average thickness of this member may be stated at 1300 feet. At Bradford it is 1281 feet."

(2.) Trans. Am. Inst. Min. Eng., vol. xv, p. 519.

(3.) *Ibid.*, vol. xvi, p. 927.

(4.) *Ibid.*, p. 929. On pp. 928 and 929 the data upon which this correlation is based are given. Briefly, it is that the Olean Conglomerate is identified in southern Allegany Co. The Cranston well No. 1, in Genesee township, shows that the Richburgh oil and gas sand is 1729 feet below the bottom of the Olean conglomerate, while at Bradford it is 1779 feet. Other wells in the Allegany district do not differ to any considerable extent in the thickness of the rocks between the Olean conglomerate and the Richburgh sand. In 1883 Mr. Carll published the statement that from the base of the Olean conglomerate to the top of the Richburgh sand was 1600′ (2d Geol. Surv. Penn., I4, p. 165.)

(5.) Ann. Rept. Geol. Surv. Penn. for 1886, Pt. II, Oil and Gas Region, p. 636.

the Olean conglomerate of Allegany Co., New York, which is as follows :

"1. Olean conglomerate.

2. Gray sandstones and sandy shale. Pocono type 175′

3. Greenish-gray sandstones and red and gray shale. Catskill type........ 225′ to 400′

4. Massive flat pebble conglomerate. Catskill type 25′ to 425′

5. A repetition of No. 3. Catskill type........ 125′ to 550′

6. Shales and flaggy sandstones. Chemung type 250′ to 800′"(1)

In reference to the correlation of this and other sections the author wrote : "In designating the different divisions on these sections, it must not be understood that the rocks belong unquestionably to the groups indicated. It is to be remembered that the divisions between Pocono, Catskill and Chemung are purely arbitrary throughout all the country under examination, for there seem to be no *positive data*, either lithological or palæontological, to indicate exactly where the dividing lines should be drawn. Red rocks are evidently no sure guide, for an abundance of red is found in one locality or another in all these groups." (2)

In 1888 Professor Henry S. Williams published a Bulletin on "The Genesee Section, New York," (3) in which the rocks of Allegany Co., N. Y. are described and compared with the Bradford section of Pennsylvania. A flat pebble conglomerate with some red jasper pebbles is described from near the head of Wolf creek, west of West Clarksville, which lies between 1,950′ and 2,000′ A. T. (4)

About five miles south of the Wolf creek conglomerate and north of Little Genesee is a conglomerate composed of round and larger pebbles forming the so-called "rock city." The Professor says : "Chemung fossils were rarely seen above the horizon of the first (Wolf creek) conglomerate and but for a short distance. After the green, micaceous and flaggy shales, and the soft, red iron shales had fairly set in, the Chemung fauna ceased."

"With the incoming of the second conglomerate of Little Genesee 'rock city,' there was deposited a coarse mixture of clay, iron ore, and yellow sand with fossils. This ferruginous sandstone is charac-

(1.) *Ibid.*, p. 639.

(2.) *Ibid.*, p. 639; also, see plate I, section 1. On p. 640, for the Bradford section, Carll makes the top of the Catskill 250′ below the base of the Olean conglomerate, which agrees closely with Ashburner's 252′. But Carll calls the Catskill 320′ thick instead of 250′, so that the top of Carll's Chemung is 570′ below the base of the Olean conglomerate, against Ashburner's 502′.

(3.) Bull. U. S. Geol. Surv., No. 41. The title page gives the date of publication as 1887; but although the copy was transmitted to the Survey on August 2, 1886, owing to delay, it was not published until the latter part of 1888.

(4.) *Ibid.*, p. 86.

terized by a *Rhynchonella* [*R. allegania* Wms.] of large size * * *, but it also contains frequent specimens of *Spirifera disjuncta*, linking its fauna with the Chemung fauna below." (1)

"The specimens [of *Rhynchonella*] have been found in the ferruginous sandstones underlying the conglomerate at Olean and Little Genesee, in New York, and at Bradford, McKean County, Pa." (2)

Again, "Above this conglomerate [Wolf creek] it is rare to find any Chemung fossils, but they do not entirely cease till the second conglomerate of Genesee 'rock city,' the Olean conglomerate. Between the two conglomerates are red and green, argillaceous shales (the former sometimes bearing Chemung fossils), with flaggy, micaceous, green shales and sandstones. The intervals between these two conglomerates may average about three hundred feet." (3)

In the "conclusions" Professor Williams states that the flat pebble (Wolf creek) conglomerate is "at the top of the Chemung and containing a fauna of decided Chemung type, which is distinct in some features, but appears in the shales below.

"These underlying shales in New York gradually run into genuine Chemung rocks and fauna and cannot be discriminated from them by any sharp line of distinction." (4)

In comparing the Allegany section with the authoritative one of the Dennis well, near Bradford, Professor Williams regards stratum No. 15 of the Dennis well as the equivalent of the Wolf creek conglomerate. (5) The top of No. 15 is 330′ below the base of the Olean conglomerate and is in the Red Catskill of Ashburner, 167′ above the top of the Chemung. (6)

As a result of this comparison it will be noticed that at Bradford,

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(1.) *Ibid.*, p. 87.

(2.) *Ibid.*, p. 88.

(3.) *Ibid.*, p. 89.

(4.) *Ibid.*, p. 103. In attempting to correlate the sandstones and shales between these two conglomerates Professor Williams' opinion was sought, and October 7th, 1891, he wrote me the following letter:

"In a geological series running upward I give the name of the typical formation, as *Chemung*, to the rocks in which the typical fauna is contained, and include as of the same formation the rocks above so long as they contain the same fauna. If the fauna changes, as in the case of the Little Genesee conglomerate, I should give the formation a different name, and in case no typical Chemung fauna occurred above I should speak of it as Upper Devonian, and not as a member of the Chemung Period.

"If the fauna changes from marine to fresh water or brackish water, in this case I would call the fauna Catskill, even if it occurred below distinct beds of Chemung, with the marine fauna, possibly giving some local name. It is the custom in this country and in Europe to consider *Spirifera disjuncta* as confined to the Devonian, so that as long as it existed, I would apply the general name Upper Devonian and Chemung."

The Professor states that the above is a general rule which he follows in the correlation of the Upper Devonian, consequently it is probably better to call the rocks between the two conglomerates simply Upper Devonian.

(5.) *Ibid.*, p. 100; also, see p. 30.

(6.) See the record of the Dennis well, 2d Geol. Surv. Penn., R, pp. 287–290, especially pp. 288, 290.

Carll places the top of the Chemung 570′ below the base of the Olean conglomerate, Ashburner 502′ and Williams 330′. Professor Williams identified specimens of *Spirifera disjuncta* Sow., *Palæanatina typa* Hall, and other fossils from the horizon which he considers the equivalent of the flat pebble conglomerate, (1) and this evidence is regarded by the writer as of greater value than that upon which Carll and Ashburner divided the section.

In support of this opinion is the additional fact that Professor Hall has referred the conglomerate at Portville, Cattaraugus Co., N. Y., to the Chemung group (2) and this conglomerate was positively identified by Professor Williams as equivalent to the Wolf creek flat pebble conglomerate. (3)

RECORDS OF THE WELLS.

The first well record to be considered is that of well No. 91 of the United Natural Gas Co., which is located on the Hatch farm, lot No. 2, in the southeastern part of Clarksville township, Allegany Co., two miles northwest of Richburgh and nearly two and one half miles southeast of West Clarksville. It was drilled during the early part of 1888 by Mr. H. W. Hatch of Richburgh, N. Y., to whose kindness I am indebted for a set of samples and from whom I have received other samples and information of much value in this investigation. No oil was obtained, but gas in sufficient amount to raise a pressure of 100 lbs. in about twenty minutes. September 15th, 1890, Mr. Hatch wrote me that he should estimate the daily production of the well as approximately 400,000 cu. ft. of natural gas.

By the aneroid barometer Mr. Gilbert D. Harris, of the U. S. Geological Survey, determined the altitude of the mouth of the well to be 625′ above the R. R. station at Richburgh. According to Mr. Frank M. Baker, Agent for Receiver of the Bradford, Eldred and Cuba

(1.) *Ibid.*, p. 101.

(2.) Geol. Surv. N. Y, Palæontology, Vol. V, pt. I, Lamellibranchiata II, 1885, under the description of three species of *Palæanatina* on pages 488–490.

In connection with the above see what Professor Hall wrote in 1867 about the Allegany Co. conglomerates: "In the collections of the geological survey these fossiliferous conglomerates were arranged as a part of the Chemung group, while the coarser non-fossiliferous rocks of similar character in Allegany and Cattaraugus counties were considered as outliers of the Carboniferous conglomerate. We have since learned, however, that the conglomerate of the southwestern counties of the State is a constituent member of the Chemung group. The red shaly and arenaceous strata, sometimes observed beneath the conglomerate, are merely subordinate beds of little significance and in no way related to the red rocks of the Catskill group to which they have sometimes been referred." (*Ibid.*, Vol. IV, pt. I, note following preface.)

(3.) Bull. U. S. Geol. Surv., No. 41, p. 90, where Prof. Williams wrote: "The fossils found at its top [the Portville conglomerate] and the relations of the rock to those below and above leave no doubt of its identity with the Wolf creek conglomerate four miles to the north."

R. R. Co., the elevation of Richburgh is 1675′ A. T., (1) which would make the altitude of the mouth of the well 2300′ A. T. (2)

The top of the Wolf creek conglomerate west of West Clarksville is stated by Professor Williams to be not over 2,000′ A. T., (3) and the rate of dip for Allegany Co. is 25′ per mile. (4)

This well is two miles + farther south than the outcrop of the Wolf creek conglomerate, so that the position of this conglomerate in the well may be called about 1950′ A. T., and the mouth of the well is 350′ higher than the Wolf creek conglomerate. (5)

According to Professor Williams the average distance between the two conglomerates is 300′. (6) Then the mouth of well No. 91 would be geologically at least near the top of the red and green shales between the 1st and 2d conglomerates and not far from the horizon of the Little Genesee or Olean conglomerate.

Record of Well No. 91, of the United Natural Gas Co. of Clarksville, Allegany Co., New York.

The depth of the well is 1441′, from it eighty-four samples of drillings were received, and since this is probably the best set of specimens from any well in the Richburgh region a concise description of each sample will be given.

No. of Sample.	Depth.	Description of Sample.	Thickness of Strata.
1.	19′.	Greenish, argillaceous shale with fragments of fossil plants. An occasional brownish-red chip. Non-calcareous.	
2.	38′.	Mainly light green, soft argillaceous shale. Two large chips of reddish, somewhat arenaceous shale.	58′ of greenish shale.

(1.) Mr. Baker also gives the elevation of Bolivar, New York, as - - - 1625′ A. T.
Little Genesee, New York, as - 1585′ "
West Clarksville, New York, as - 1697′ "
all of which stations are not mentioned in the 2d edition of Gannett's "Dictionary of Altitudes in the U. S." Bull. U. S. Geol. Surv., No. 76, 1891.

(2.) The above elevation of the well is somewhat more than Mr. Hatch's determination. At first Mr. Hatch reported it as about 575′ above the R. R. station at Bolivar, which would make the elevation about 2200′ A. T.; but in a subsequent letter, January 24th 1891, he called the altitude 2225′. Mr. Harris states that "520′ of the height has actually been leveled, and I can vouch for the other hundred." (Letter, October 9th, 1891.)

(3.) Bull. U. S. Geol. Surv., No. 41, p. 86.

(4.) *Ibid.*, p. 103.

(5.) Mr. Harris wrote Oct. 23: "Conglomerate fragments are by no means rare over the whole Richburgh area; but I noticed particularly fossiliferous conglomerate fragments between the altitudes 250′–350′ below the top of well No. 91. In fact, I saw no fossils in place above these altitudes in any of the rocks. No red beds were seen, the rocks as exposed along the roads were light-colored, mainly bluish-greenish and generally not thick bedded and arenaceous, but shaly. This applies only to beds exposed along the highway from altitudes 200′–400′ below the mouth of No. 91."

(6.) *Ibid.*, p. 89.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	THICKNESS OF STRATA.
3.	58'.	Mainly dark red finely arenaceous chips.	19' red shale.
4.	77'.	Mainly micaceous, greenish-gray, moderately coarse grained sandstone (?). A few dark red arenaceous chips.	
5.	96'.	Light gray sandstone, composed mostly of quartz grains, a little coarser than No. 4.	
6.	116'.	Ditto.	
7.	135'.	Slightly greenish-gray and finer grained chips than Nos. 5 and 6.	77' gray sandstone.
8.	154'.	Mostly bluish, argillaceous shale with some olive chips.	20' bluish shale.
9.	174'.	Grayish-buff, micaceous, fine grained sandstone (?).	19' sandstone.
10.	193'.	Bluish-gray, argillaceous and finely arenaceous shale.	19' shale.
11.	212'.	Mixture of blue and reddish, argillaceous shale with greenish-gray sandstone (?).	
12.	232'.	Bluish, argillaceous shale with light gray sandstone (?).	39' shale and sandstone (?).
13.	251'.	Clear blue, argillaceous shale, slightly arenaceous.	
14.	270'.	About the same as No. 13.	
15.	290'.	Ditto.	
16.	309'.	Bluish to greenish, argillaceous shale.	
17.	328'.	Bluish, argillaceous shale.	
18.	348'.	Blue shale with a few grayish, arenaceous chips.	
19.	367'.	Ditto.	155' mainly blue shale.
20.	386'.	Ditto.	
21.	406'.	Mixture of brownish-red, finely arenaceous chips with gray arenaceous and blue shale.	19' mottled shales (?).
22.	425'.	Fine powder of dark gray color.	
23.	444'.	Bluish-gray, argillaceous shale, a little coarser chips than No. 22.	

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	THICKNESS OF STRATA.
24.	464′.	Mainly gray, finely arenaceous shale (?), with a few bluish and brownish-red arenaceous chips.	
25.	483′.	Mainly olive to grayish, argillaceous shale, a few brownish-red chips.	97′ grayish
26.	502′.	Olive to grayish, argillaceous shale.	shale (?).
27.	522′.	Mainly light gray, fine grained, micaceous sandstone (?).	19′ sandstone (?).
28.	541′.	Greenish-gray, argillaceous shales.	
29.	560′.	Ditto.	39′ shales.
30.	580′.	Bluish, argillaceous shale and light gray, fine grained sandstone (?).	38′ blue shale and
31.	599′.	Ditto.	sandstone (?).
32.	618′.	Clear olive, argillaceous shale.	20′ olive shale.
33.	638′.	Fine chips of light gray, fine grained sandstone.	19′ gray sandstone.
34 (?).	657′.	Bluish, argillaceous shale.	19′ bluish shale.
35.	676′.	Light-gray, fine grained sandstone mixed with blue shale.	
36.	696′.	Ditto.	
37.	715′.	Ditto.	
38.	(Wanting.)		
39.	759′.	Ditto.	
40.	770′.	Ditto, only rather more of the bluish, somewhat arenaceous chips. (1st sand of Mr. Hatch.)	116′ mainly gray sandstone.
41.	792′.	Mostly bluish, finely arenaceous shale (?).	38′ shale
42.	812′.	Light gray sandstone, mixed with bluish chips.	and sandstone (?).
43.	830′.	Olive, argillaceous shale mixed with red, oölitic iron ore. (1)	16′ olive shale and red iron ore.
44.	846′.	Olive to bluish, argillaceous shale.	
45.	(Wanting.)		

(1.) Prof. Williams found oölitic red iron ore in an olive shale near Cuba, Allegany Co. (Bull. U. S. Geol. Surv., No. 41, pp. 67, 69.) The Cuba locality is about nine miles north of this well with an approximate altitude of 1700′. If we call the dip 25′ per mile for the nine miles, then the position of the iron ore in well 91 ought to be at about 1475′ A. T. Calling the altitude of the mouth of the well 2300′, then the iron ore actually found in the well is at an altitude of 1470′ A. T.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	THICKNESS OF STRATA.
46.	879'.	About the same as No. 44, with a few brownish-red chips.	
47.	(?) 896'.	Ditto.	
48.	(?) 912'.	Bluish-gray and somewhat arenaceous.	
49.	929'.	Bluish-gray and light gray, somewhat arenaceous chips. The light gray are calcareous.	
50.	945'.	Olive, argillaceous shale, some of the chips micaceous and somewhat arenaceous, a few slightly purplish.	
51.	962'.	Olive to greenish-gray, argillaceous shale, slightly micaceous and arenaceous.	165' mainly
52.	978'.	Olive to bluish-gray, argillaceous shale, a few slightly purplish chips.	olive to bluish-gray
53.	995'.	Bluish-gray and light gray calcareous chips.	argillaceous shale.
54.	1011'.	Greenish-gray, finely arenaceous sandstone (?).	49' greenish-
55.	1028'.	Ditto.	gray sand-
56.	1044'.	Ditto, only slightly more calcareous.	stone (?).
57.	1060'.	Darker gray sandstone, with some olive, argillaceous shale. (2d sand of Mr. Hatch.)	
58.	1075'.	Ditto, mixed with bluish shale.	
59.	1090'.	Gray, fine grained sandstone mixed with bluish shale.	60' gray
60.	1105'.	Gray sandstone and shale mixed.	sandstone.
61.	1120'.	Greenish-gray shale (?) with fragments of fossils.	
62.	1135'.	Olive, argillaceous shale, slightly arenaceous.	
63.	1150'.	Mostly dark to slightly brownish-gray chips, some olive shale.	
64.	1165'.	Olive, argillaceous shale.	
65.	1180'.	Olive, slightly arenaceous chips.	
66.	1195'.	Dark gray shale with some light gray, finely arenaceous sandstone (?).	
67.	1210'.	Mainly greenish-gray, argillaceous shale.	135' mostly
68.	1225'.	Ditto.	olive and
69.	1240'.	Ditto.	gray shale.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	THICKNESS OF STRATA.
70.	1255′.	Light gray, fine grained sandstone mixed with greenish-gray shale.	
71.	1270′.	Mainly slightly darker gray sandstone with some shale.	30′ light gray sandstone.
72.	1285′.	Mainly slightly brownish-gray, fine grained sandstone, with a little shale. Fragments of fossils. (Stray sand of Mr. Hatch.)	
73.	1300′.	Very fine chips of the brownish-gray sandstone.	
74.	1315′.	Ditto, only larger chips with small fragments of fossils and some shale.	
75.	1330′.	Clear sample of brownish-gray sandstone. Fragments of fossils (?).	
76.	1345′.	Sandstone with some arenaceous shale.	
77.	1357′.	Brownish-gray sandstone with a little shale. Duplicate of No. 75. (Top of gas sand of Mr. Hatch.)	
78.	1369′.	Ditto, with very little shale. Fragments of shells (?).	
79.	1382′.	Brownish-gray sandstone mixed about equally with greenish-gray shale. Fragments of fossils. (Bottom of gas sand of Mr. Hatch.)	108′ mainly brownish gray sandstone.
80.	1393′.	Greenish-gray, argillaceous shale.	
81.	1404′.	Ditto, with slightly brownish-gray sandstone.	22′ shale.
82.	1415′.	Mainly slightly brownish-gray, fine grained, micaceous sandstone. A little greenish-gray, argillaceous shale. (Top of oil sand of Mr. Hatch.)	
83.	1428′.	Ditto.	
84.	1441′.	Some of the brownish-gray sandstone, but more of the greenish-gray shale. (Bottom of the oil sand of Mr. Hatch.) Bottom of well.	26′ brownish-gray sandstone.

The facts brought out by the above record may be expressed in the following concise diagrammatic form.

SECTION OF WELL NO. 91, CLARKSVILLE, ALLEGANY CO., NEW YORK.

Approximate Altitude 2300′ A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.
	58′	Greenish shale.
58′		
	19′	Red shale (?).
77′		
	77′	Gray sandstone.
154′		
	20′	Bluish shale.
174′		
	19′	Grayish-buff sandstone (?).
193′		
	19′	Bluish-gray shale.
212′		
	39′	Mixed shale and sandstone (?).
251′		
	155′	Blue shale.
406′		
	19′	Mottled shale (?).
425′		
	97′	Grayish shale (?).
522′		
	19′	Light gray sandstone.
541′		
	39′	Greenish-gray shale.
580′		
	38′	Blue shale and light gray sandstone (?).
618′		
	20′	Olive shale.
638′		
	19′	Light gray sandstone.
657′		
	19′	Bluish shale.
676′		
	116′	Mainly light gray sandstone. (1st sand at 770′.)
792′		
	38′	Bluish shale and light gray sandstone (?).
830′		
	16′	Olive shale mixed with red iron ore.
846′		
	165′	Mainly olive to bluish-gray shale.
1011′		
	49′	Greenish-gray sandstone (?).
1060′		
	60′	Gray sandstone. (2d sand at 1060′.)
1120′		

DEPTH.	THICKNESS.	KIND OF ROCK.
	135′	Mostly olive and gray shale.
1255′	——	
	30′	Light gray sandstone.
1285′	——	
	108′	Mainly brownish-gray sandstone. { Stray sand at 1285′. Top of gas sand at 1357′. Bottom " " " 1382′. }
1393′	——	
	22′	Greenish-gray shale.
1415′	——	
	26′	Brownish-gray sandstone. { Top of oil sand at 1415′. Bottom " " " 1441′. }
1441′	——	Bottom of well.

In December, 1887, Mr. Hatch sent me three specimens of gas sand containing fossils, which were thrown out of the well by the explosion of a "shot." The specimens came from well No. 90 of the United Natural Gas Co., which, according to Mr. Harris, is 700′ west of and 10′ higher than well No. 91. Mr. Hatch wrote December 10th, as follows: "I have sent you some very fine specimens of our gas sand, showing the finest and most perfect fossils that I have seen in this field." Unfortunately, owing to change of residence, these valuable specimens have been mislaid among the large collections of Devonian material at Cornell University. At the time of their receipt the fossils were examined rather hastily and *Spirifera* (*S. disjuncta* I think) and *Rhynchonella* were recognized.

In March, 1891, Mr. Hatch forwarded me some large specimens of oil sand from another well on the Hatch farm; but 184′ lower than well No. 91. The top of the oil sand in this well is 1236′ and the bottom 1270′. The top of the oil sand in this well agrees very closely with that of well No. 91; 1415′, depth in No. 91, — 184′ = 1231′, a difference of only five feet. March 27th, Mr. Hatch wrote: "These pieces are different sand from any of those among the samples of well No. 91. The difference between them is that these specimens are from a productive oil bearing rock, while the oil sand of No. 91 is a barren rock taking the place of the other and better sand."

In the interpretation of these well records there are several differences from published observations.

1st. If the altitude of the mouth of well No. 91 be correct, then we might expect indications of the Wolf creek conglomerate in the samples from near 350'. But the drillings show a quartz sandstone from 96' to 116' and possibly at 135', which is lithologically nearer what would be expected for the Wolf creek conglomerate than the lower sandstones. At 174' is a grayish-buff sandstone (?) and from 212' to 251' a mixture of shale and gray to greenish-gray sandstone (?), then from 251' to 406' nearly bluish, argillaceous shale.

2d. If the mouth of the well is 2300' A. T. and near the horizon of the Olean conglomerate, and if the top of the Richburgh oil sand was reached at 1415', or 1420' according to the last well, then the distance from the base of the Olean conglomerate to the top of the Richburgh oil sand is only about 1420' instead of 1729' as stated by Ashburner, (1) a difference of about 300.' Or, if Ashburner were correct as to the distance, then the bottom of this well would be about 300' above the top of the Richburgh oil sand. However, Mr. Hatch is confident that the well reached the oil sand and wrote me October 16, 1891, as follows: "I am certain that wells No. 90 and 91 are through the Richburgh oil and gas level. The bottom of the well No. 90 is 1499'; below the regular gas sand nothing was found except slate."

3d. Data given by Professor Williams are both for and against the opinion that wells No. 90 and 91 reached the horizon of the Richburgh oil sand. Against it is the fact that fragments of fossils were noted from the brownish-gray sandstone as low as 1382', which is stated by Mr. Hatch to be the bottom of the gas sand, and good specimens of fossils were sent from the gas sand of well No. 90. Professor Williams stated that in the oil sand of Varney & Co.'s well No. 11 at Bolivar, "no traces of fossils were seen." And the Professor concluded: "It is probable that this sandstone [Richburgh oil sand] is represented at the surface farther north by the Portage sandstones at Portageville." (2) Also, when describing the outcrop at Portageville, the Professor said: "The petroleum odor associated with all these gray sandstones following the black shales of the Portage group, gives strong reason for the opinion that they are the sandstones which occur farther south, and there, covered by thick masses of overlying strata, contain the oils reached by drilling." (3)

(1.) Trans. Am. Inst. Min. Eng., vol. xvi, pp. 928, 929. There is a slight discrepancy in Ashburner's account of the Cranston Wells, Nos. 1 and 2, on lot 29, Genesee township, from which this distance was obtained. On page 928 it is stated that the top of the Richburgh oil sand was struck in well No. 1 at a depth of 1704' and in the table on p. 932 it is given as 1632', a difference of 72'. On p. 928 well No. 2 reached the Richburgh sand at 1709' and on p. 932 at 1655', a difference of 54'.

(2.) Bull. U. S. Geol. Surv., No. 41, p. 90.

(3.) *Ibid.*, p. 52.

If Professor Williams' correlation of the Richburgh oil sand with the Portage sandstone be correct, then the fossils in the gas sand of the wells on lot No. 2 prove that they did not reach the Richburgh sand.

On the other side, assuming that the elevation of the mouth of well No. 91 is 2300′ A. T., and comparing the elevation of the top of the oil sand above sea level with that of the Richburgh wells, we find that there is not much difference. The top of the oil sand in well No. 91 is about 880′ A. T., and Professor Williams states that the average altitude of the top of the Richburgh oil sand in nine of the Varney & Co. wells "is 800 feet above the sea, or something over a thousand feet below the flat pebble conglomerate of the Upper Chemung." ([1]) Professor Williams also makes the distance from the base of the Olean conglomerate to the top of the Richburgh oil sand about the same as in well No. 91. The top of the flat pebble conglomerate is given as 1875′, which is based on the supposition that the R. R. station at Bolivar is 1600′. Since the station is 1625′, then the top of the conglomerate would be 1900′ A. T. 1900′ — 800′ (top of oil sand in wells) = 1100′ for the distance from the flat pebble conglomerate to the top of the oil sand. 1100′ + 300′ (average distance between the conglomerates) = 1400′ for the distance from the base of the Olean conglomerate to the top of the Richburgh oil sand.

Since well No. 91 is not much farther north than the Varney & Co. wells, the above statements seem to show that well No. 91 did reach the Richburgh oil sand; that this sand, or at most only 33′ above it, is fossiliferous containing Chemung species and consequently that the Richburgh sand is in the Chemung. If this correlation be correct then the Richburgh oil sand is above the Portage sandstones and Ashburner was correct in referring the Allegany oil sandstones to the Chemung. ([2])

It appears to the writer that the explanation of the confusing views on the stratigraphical geology of southwestern New York and northwestern Pennsylvania is due in great measure to the belief of some geologists in the "persistent parallelism of strata" for considerable distances. While, as a matter of fact, it is probable that the lith-

(1.) *Ibid.*, p. 90.

(2.) 2d Geol. Surv. Pa. R, 1880, in the "vertical section of the rocks of McKean Co.," on p. 43 the Bradford oil sand is given as middle Chemung. And in the Trans. Am. Inst. Min. Eng., vol. xvi, pp. 927, 929, the Richburgh oil sand is positively correlated with the Bradford oil sand by Ashburner.

ological characters of these strata change decidedly in the course of not very considerable distances. Professor Williams in reviewing the geology of this region has admirably stated this opinion in the following language: "The fact seems to be, as we review the records of the survey [Pennsylvania] that the data of lithologic character of rocks and of the thickness of the deposits were so constantly variable that the 'theory of persistent parallelism of strata' was little more than a theory, the exceptions to which were as numerous as the illustrations. It was a cut-and-try system of matching together innumerable sections, made up of irregular combinations of shales, sandstones, conglomerates, and limestones of various color, thickness and texture. Whenever the gaps were over a mile or two long the adjustment of the theoretical dip, a few feet more or less to the mile, would enable the parallelism to fit any particular stratum in a given section. The fact that those who showed evidence of having noted the fossils, although they may not have identified them, were invariably nearer right than those who neglected them, strengthens the belief that the fossils, even in this case, were the most valuable means of correlation." (1)

In reference to the stratigraphical geology of the Allegany region, Professor Williams wrote me as follows, October 31, 1891: "Regarding the relations of the Richburgh sands and the Olean conglomerate, I remember that at the time [when writing Bulletin No. 41] the statistics were confusing. I was then inclined to the opinion that there were very sudden changes in the neighborhood of the oil sands—laterally—*i. e.* on passing across the strata horizontally; and later studies led me to consider the 'theory of persistent parallelism of strata' very unsatisfactory as a means of correlation. It may be satisfactory, then the next half mile may give perfectly unsatisfactory results. I think only the fossils can be depended upon and even these must be examined as faunas as well as individuals, for obtaining the best results in correlation."

(1.) Bull. U. S. Geol. Surv., No. 80, pp. 111, 112.

CLARKSVILLE WELL, ABOUT ONE MILE SOUTHWEST OF WEST CLARKSVILLE, ALLEGANY CO., NEW YORK.

Altitude about 1736′ A. T.

DEPTH.		CHEMUNG STAGE.
100′	----	Olive, argillaceous shale, slightly calcareous.
125′	----	Lithologic characters about the same, fragments of Brachiopod shells, (? *Productella.*)
150′	----	Ditto, fragments of Brachiopods (one possibly a *Discina.*)
200′	----	Light gray and olive chips, calcareous with fragments of shells.
275′	----	Mostly light gray sandstone, with fragments of Brachiopods.
375′	----	Darker gray sandstone with fragments of Brachiopods. "First sand" of driller.
410′	----	Light gray, fine grained sandstone, salt water. "Salt sand" of driller.
435′	----	Olive to greenish-gray argillaceous shale, fragments of shells.
675′	----	Light gray sandstone mixed with dark gray argillaceous shale. "Second sand" of driller.
750′	----	Ditto, with fragments of fossils.
800′	----	Greenish-gray argillaceous shale with fragments of fossils.
900′	----	Brownish, micaceous sandstone which contains plenty of Brachiopod fragments. Called the "Richburgh or Bolivar sand" by driller.
925′	----	Greenish to dark gray argillaceous shale.
975′	----	Mainly brownish-gray sandstone, fragments of fossils.
1055′	----	The Clarksville oil sand. Greenish-gray argillaceous shale.
		Bottom of well.

The Clarksville well was drilled during October, 1891, and I am indebted to Mr. T. B. Love, of West Clarksville, for a set of samples and a record of this well. Mr. Love states that the Clarksville oil sand, which he considers as 75 feet below the Richburgh or Bolivar sand, is 30 feet in thickness. There is no gas, except in the oil sand, and then only a small amount. The wells start with eight to ten bbls. of oil per day, but in about thirty days decline to two or three bbls.

and will yield that amount for years ; the sand being close grained, it drains slowly.

From the central and northern portions of Allegany Co. the writer has not yet been fortunate enough to secure specimens for examination. On this account it is not possible to correlate positively the bottom of the Richburgh wells with those of the southern part of Wyoming Co. A number of wells have been drilled in this region and the drillers' record of several is given below ; but without samples for examination it is not safe to attempt the correlation of these records. ([1])

(1.) June 6th, 1891, Mr. A. W. McQueen, of Nile, Allegany Co., N. Y., furnished me the following partial records of wells drilled by himself in this region.

"A well at Nile 'getting the sand' at 1200′ would commence in blue slate (or shale) and continue the same to about 400′, excepting three or four white sands, from 3′ to 5′ thick. From 400′ to 600′ is mostly a hard blue rock, having marble white streaks in places ; at about 600′ we get a white sand 20′ to 30′ thick [1st sand ?]. Soft blue rock now runs the well down to 880′, where we get the second sand, which is about 20′ thick, dark colored and followed by 10′ of blue slate, after which we get the same sand again, this time with salt water (about ½ barrel an hour). This is followed by 270′ of what seems to be a pure slate, not a particle of grit in it, until the last 20′ or 30′, when a few little 'shells' are met with ; only a little 'skim' of oil sand is found here, 3′ to 8′, and wells produce from 2 to 15 barrels per day. For a distance of 400′ below the oil sand there is nothing but a dark colored slate rock."

The above record may be expressed diagrammatically as follows:

SECTION AT NILE, N. Y.

Depth.	*Thickness.*	*Kind of Rock.*
	400′	Blue shale.
400′		
	200′	Hard blue rock with marble white streaks.
600′		
	30′	White sand [1st sand (?)].
630′		
	250′	Soft blue rock.
880′		
	20′	"2d sand," dark colored.
900′		
	10′	Blue slate.
910′		
	?	Sand again with salt water.
?		
	270′	Pure slate, no grit until the last 20′ to 30′ when there are a few "shells." Oil sand 3′ to 8′.
1200′ (?)		
	400′	Dark colored slate.
1600′ (?)		

"A well drilled in Friendship village had the same formations down to and including the salt water ; below which we found only a soft blue slate or shale, getting quite dark colored when we had finished at 600′ below the salt water. Total depth of well 1330′ and it was located about 20′ above the N. Y., L. E. & W. R. R. station." The altitude of the N. Y., L. E. & W. R. R. station at Friendship is 1539′ (Bull. U. S. Geol. Surv., No. 76, p. 143) which would make the altitude of the mouth of this well about 1560′.

Two wells were drilled by Mr. McQueen near Marshall, in New Hudson township, about five miles from the Genesee river. "No. 2 was on the level of Crowford creek and was drilled to the depth of 2075′. No gas or oil and no sand rock, except a very little near the top of the well. From 1200′ to bottom of well the rock was nearly or quite all slate ; at about 1800′ a rock filled with copper-colored particles, supposed to be iron pyrites, 20′ to 30′ thick ; below this a soft slate, nearly a perfect coal black, and finished with the rock still very dark colored. No. 1 was about 1000′ from the 2d, was drilled about 1400′ and found a little gas which burned for two weeks.

"Another well four miles from Belfast, on Wigwam creek, in Allen township, was drilled to a depth of 1520′. The formations were about the same, though I found at 720′ about three feet of close (very fine) white sand with gas and oil. The well made a barrel of oil per day for a week or so when gas and oil failed. The oil was of very light color.

"All wells in the northern part of this county showed a soft slate or shale formation, light in color at the top and dark at the bottom."

The next well record, that is of value for this general section, is that of one drilled in 1883, near Castile, Wyoming Co., New York.

At Portage Falls, near Portageville, the top of the Portage sandstones, which form the summit of the Portage stage, has an approximate altitude of 1200′. (1) Castile is approximately four miles north of Portageville, and if the dip in this region be about 50′ to the mile as stated by Professor Williams, (2) then the top of the Portage sandstone at Castile would be in the neighborhood of 1400′ A. T. The altitude of the N. Y., L. E. & W. R. R. station at Castile is 1400′, (3) or at the "Summit" 1431′, which would be about the horizon for the top of the Portage. This probable geological horizon for the mouth of the Castile well is confirmed by the statement of Professor Irving P. Bishop, who stated that it "started in the sandstones of the Upper Portage, * * * * being also at nearly the highest elevation of the Erie R. R. between New York and Buffalo. It is also the deepest well yet sunk in the salt district." (4)

Mr. Geo. H. Bush, of Castile, furnished me with a partial record of this well together with some specimens of drillings. A section of this well is given by Professor Bishop (5) and from this data, in connection with the information furnished by Mr. Bush, the following section has been compiled.

(1.) Bull. U. S. Geol. Surv., No. 41, p. 52

(2.) *Ibid.*, p. 103.

(3.) Gannett, in Bull. No. 5, U. S. Geol. Surv., p. 205, gave Castile as 1401′ and Castile summit 1431′. In the 2d Ed., Bull. No. 76, p. 78, Castile is given as 1431′. In Macfarlane's Am. Geol. Railway Guide, 2d Ed., p. 125, Castile is given as 1401′. October 10th, 1891, Mr. Carl W. Buchholz, Civil Engineer of the N. Y., L. E. & W. R. R. Co. gave me the following altitude of stations, taken from the lithograph profile of the "Erie" R. R.

Portage	1314′
Castile	1400′
Silver Springs	1406′
Rock Glen	1331′
Warsaw	1326′

The altitude of Silver Springs and Rock Glen is not given in Bull. U. S. Geol. Surv., No. 76.

November 7, 1891, Mr. Geo. H. Bush of Castile, wrote me that the mouth of the Castile well is about fifty rods from the N. Y., L. E. and W. R. R. station and about 10′ lower than the R. R. track; which would make the altitude of the mouth of the well about 1390′.

(4.) Rept. on the Salt Fields of western New York. In 5th Ann. Report of the State Geologist [of New York] for the year 1885. Assembly Doc. for 1886, No. 105, p. 24.

(5.) *Ibid.*, pp. 25, 26. The section is copied by Dr. Engelhardt in the Ann. Rept. Supt. Onondaga Salt Springs for 1888. Assembly Doc. for 1889, No. 43, Charts No. II and IV ; also, see p. 19.

SECTION OF CASTILE WELL,

from data given by Professor Bishop and Mr. Bush.

Approximate altitude 1390′ A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	49′	Soil.	
49′	----	Near top of Portage.	
	180′	"Argillaceous sandstone, 175′—180′." (1)	Portage.
229′	----		
	786′	"Blue shale, nearly uniform in color and hardness."	Genesee.
1015′	----		
	10′	"Flint shell (?)."	
1025′	----		
	650′	"Building stone, nearly like the first."	Hamilton.
1675′	----		
	100′	"Black shale, lower part much darker than the upper."	Marcellus.
1775′	——		
	140′	"Corniferous limestone."	Upper Helderberg.
1915′	----		
	320′	"Alternate layers of hard and soft rocks."	Lower Helderberg.
2235′	----		
	100′	"Soft slate saturated with brine."	Onondaga Salt group. (3)
2335′	----		
	35′	"Salt and shale mixed."	
2370′	----		
	45′	"Clear rock salt."	
2415′	----		
	40′	"Shales."	
2455′	----		
	70′	"Salt and shale, five feet of which was salt." (2)	
2525′	——		
		Bottom of well in bluish-gray marl and limestone. Salt crystals.	

(1.) In the totals for the well it is evidently called 180′.

(2.) Mr. Bush writes that 65′ of this stratum was pure rock salt. Dr. Engelhardt states that the well "is 2,525′ deep, with two salt beds, the upper forty-five feet thick, followed by forty feet shale, and a lower one, which was penetrated seventy feet without passing through this rock-salt vein" (*Ibid.*, p. 19.) But on Charts II, III and IV, accompanying this report Engelhardt has followed Bishop precisely.

(3.) In the above section it is possible to indicate only in a general way the position of the different terranes.

Although the first stratum of rock salt is about 2400′ in depth, some 600′ deeper than in the Warsaw wells, still it has been worked and Mr. Bush informs me that several thousand barrels of salt have been manufactured.

At Silver Springs, two miles northwest of Castile, are the salt works of the Duncan Salt Co., who have drilled five wells at this place.

Section of Silver Springs Well.

Compiled from data given by Professor Bishop. ([1])

Approximate altitude 1391′ A. T. ([2])

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	222′	"Gravel and quicksand."	Portage.
222′	----		Genesee.
			Hamilton.
	1299′	"Slate and sandstones."	Marcellus.
1521′	——		
	140′	"Corniferous limestone."	Upper Helderberg.
1661′	----		Lower Helderberg.
	320′	"Limestone (Helderberg (?))."	
1981′	----		
	128′	"Slate."	
2109′	----		
	15′	"Salt and shale mixed."	
2124′	----		Onondaga
	10′	"Pure salt."	Salt group.
2134′	----		
	45′	"Slate."	
2179′	----		
	75′	"Salt, pure."	
2254′	——	Bottom of well.	

(1.) Fifth ann. Rept. State Geologist [of New York] for 1885, p. 25. Dr. Engelhardt mentions three wells at this place, and states that there are "two salt veins of twenty and sixty feet thickness in each, separated by thirty-five to forty feet shale" (Ann. Rept. Supt. Onondaga Salt Springs, for 1888, p. 19). But on Chart II Engelhardt copies Professor Bishop's section without change and the data on Chart III also agree with Bishop.

(2.) October 29th, 1891, Mr. J. W. Duncan, President of the Duncan Salt Co., wrote me that the above well was about 1500′ south of the N. Y., L. E. & W. R. R. station at Silver Springs and about 15′ below the level of the railroad.

At Perry, six + miles NNE of Castile, two wells have been drilled and from the first of these wells samples were obtained daily by Professor I. P. Bishop, who kindly sent them to me for re-examination.

SECTION OF THE PERRY WELL. (1)

Approximate altitude 1350′ A. T. (2)

DEPTH.	KIND OF ROCK.	FORMATION.
176′	Argillaceous and finely arenaceous shale of light gray color.	Portage.
259′	Dark gray, clear, argillaceous shale; streak white.	
380′	Ditto, some of the fragments with a slightly brownish streak but mostly with a white streak.	
560′	Blackish, argillaceous shale with fairly brownish streak.	
620′	Gray, argillaceous shale with white streak, non-calcareous.	
775′	Slightly darker gray argillaceous shale, non-calcareous, streak white.	
800′	Dark gray argillaceous shale with brownish-gray streak, non-calcareous.	
920′	Bluish-gray argillaceous shale, calcareous. Fossils, especially Bryozoans.	Hamilton. (3)
1000′	Grayish, calcareous, argillaceous shale. Fossils, Crinoid stems	
1135′	Bluish-gray, calcareous, argillaceous shale. Fossils, *Chonetes*, *Ambocœlia umbonata* (Con.) Hall.	
1284′	Very dark gray, argillaceous shale; calcareous and fossiliferous with a slightly brownish streak.	
1462′	Dark gray limestone, strong effervescence in HCl.	Upper Helderberg.
1475′	Ditto.	
1520′	Light gray limestone with strong effervescence.	
1675′	Dark gray limestone, which effervesces very slowly in cold HCl, and is increased on heating.	Onondaga Salt group.

(1.) Prof. Bishop gives an interesting account of this well in the 5th Ann. Rept. State Geologist [of New York] for 1885, pp. 24, 25.

(2.) Prof. Bishop writes me that he has been unable to secure the authentic elevation of the mouth of this well; but from his knowledge of the slope from Castile it is estimated to be within 10′ of 1350′ above tide. The well is located within the corporation and near the railroad station.

(3.) The top of the Hamilton is probably higher in the well, possibly between the samples from 620′ and 775′; but the samples are not complete enough in order to show the division between the Genesee and Hamilton.

DEPTH.	KIND OF ROCK.	FORMATION.
1710′	Partly lighter gray chips than the above with stronger effervescence in cold HCl.	
1770′	Dark gray chips ; scarcely any effervescence in cold HCl, but effervesces slowly on heating.	
1839′	Dark gray to drab magnesian limestone. Last sample.	Onondaga Salt group.

At Rock Glen, five and three-fourths miles north-west of Castile and about three miles south of Warsaw village, a number of wells have been drilled. The salt works of Alexander Kerr, Brother & Co., are located at this place and through the kindness of Mr. Sam'l T. Kerr an excellent set of samples was obtained from one of their wells. The well was commenced in November, 1890, and finished in January, 1891. Its mouth, according to Mr. Kerr, is about 25′ below the tracks of the N. Y., L. E. & W. R. R., which would make its altitude about 1306′ A. T., and it was drilled to a depth of 2138′.

Detailed Record of the Kerr Well at Rock Glen, Wyoming Co., New York.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	
1.	20′.	Coarse gravel.	
2.	40′.	Clay 20′.	
3.	70′.	Fine gravel.	
4.	95′.	Arenaceous clay ; top of rock.	95′ of drift.
5.	114′.	Three large chips, one fine grained micaceous, greenish-gray sandstone ; the others argillaceous, olive shale that can be scratched by the nail. Characteristic Portage shale and sandstone.	
6.	185′.	Fine chips of slightly arenaceous, grayish to olive shales.	
7.	285′.	Gray shales, some of the chips have a slightly brownish streak, slightly calcareous.	
8.	350′.	Dark gray, argillaceous shale, not calcareous, streak nearly white.	Portage
9.	410′.	Ditto.	sandstones
10.	475′.	Very argillaceous grayish to olive shales.	and shales.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	
11.	550'.	Mainly a blackish, argillaceous shale with brownish streak. This is hardly typical Genesee shale ; but if not Genesee is similar to a recurring black shale which has been described by Professor Williams and others from surface outcrops. ([1])	Genesee (?).
12.	600'.	Ditto.	
13.	650'.	Ditto.	Genesee.
14.	700'.	Dark gray to bluish, argillaceous slightly arenaceous shale. Streak white, non-calcareous.	
15.	750'.	Gray argillaceous shale. One chip contains two small Lamellibranchs, one of which resembles a young shell of *Nucula bellistriata* (Con.) Hall ; and one specimen of *Styliola fissurella* Hall.	
16.	800'.	Lithology same as No. 15.	
17.	850'.	Darker gray, argillaceous shale.	
18.	900'.	Dark gray shale, part of it finely arenaceous. Some of the chips have a slightly brownish streak, slightly calcareous, with "a flow of gas."	
19.	950'.	Light gray, argillaceous shale, streak white, quite calcareous. A dorsal valve of a *Discina*, which may be compared with *D. doria* Hall, and a fragment of another shell.	
20.	1000'.	Shale, ditto. "Gas sufficient for 5 or 6 lights, or for 2 stoves. The volume was greater and the flow steadier than in any other well we have had [in the Warsaw region]" Mr. S. T. Kerr.	

(1.) Bull. Geol. Surv., No. 41, pp. 23-25, 31-34, 41, 47-50.

Prof. Hall, in 1879, called attention to this fact in central and western New York and said "this black slate [Genesee] is succeeded by a green or olive slate or shale, followed by successive alternations of black or greenish shales" (Geol. Surv., N. Y. Palæontology, vol. v, pt. II, pp. 150, 151).

Then Dr. Clarke, in 1885, described a "Lower and Upper Black Band" in the Naples Shales of Ontario Co., of which he said : "Further west they lose their persistency and become a series of thin beds alternating with the greenish shales and flag-stones" (Bull. U. S. Geol. Surv., No. 16, pp. 36, 37).

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	
21.	1050'.	Light gray, calcareous shale, effervesces slightly in HCl. There is another box marked "1050' limestone," which has very fine chips of dark gray color, with strong effervescence. Similar to a limestone.	
22.	1100'.	Very light to darkish gray, strongly calcareous chips. Fragments of fossils.	
23.	1150'.	Dark gray, argillaceous shale, quite calcareous with slight brownish streak.	
24.	1200'.	Dark to bluish gray shale. Streak slightly brownish, quite calcareous. Fragment of a fossil shell, (?) *Spirifera mucronata* (Con.) Billings.	
25.	1250'.	About the same as No. 24.	
26.	1300'.	Dark gray argillaceous shale.	
27.	1350'.	Nearly black, argillaceous shale which is slightly arenaceous. Streak slightly brownish; somewhat calcareous.	Hamilton.
28.	1400'.	Black, argillaceous shale, with dark brown streak and non-calcareous. Drillers log "black shale 45'."	Marcellus.
29.	1450'.	Dark and light gray, fine chips, which are strongly calcareous. Some of the black Marcellus. Drillers "sand rock; Corniferous limestone."	
30.	1500'.	Light gray limestone; very finely powdered, strong effervescence. Drillers "hard sandy limestone."	
31.	1550'.	Ditto.	
32.	1590'.	Ditto. Drillers log "bottom of hard sandy limestone, thickness 140'."	Upper Helderberg.
33.	1700'.	Dark gray limestone with very fine chips. Effervescence not strong at first in cold HCl, but gradually increases. One of the somewhat magnesian limestones of the Onondaga Salt group.	
34.	1753'.	Ditto.	

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.	
35.	1800′.	Rather dark gray to drab limestone, effervescence slow at first, but becomes strong on heating the HCl ; a magnesian limestone.	
36.	1850′.	Same as preceding with small fragments of white gypsum.	
37.	1900′.	Greenish and brownish red marlytes or calcareous shales. Some fine white chips, probably selenite. Drillers log " through the limestone." Upper part of the lower division of the Onondaga Salt group.	
38.	1950′.	Mostly greenish, finely arenaceous and but slightly calcareous shales (?). Effervescence increased by heating the HCl ; but does not become strong. Some brownish red chips. " Sandy shale " of driller.	
39.	2000′.	Ditto.	
40.	2030′.	Top of 1st rock salt stratum, 15′ thick.	
41.	2045′.	Greenish marlyte, effervescence strong after being a short time in HCl. Drillers log " 40′ of shale."	
42.	2085′.	Top of 2d rock salt stratum, 50′ in thickness, 2135′ bottom of rock salt.	
43.	2136′.	Mainly fine chips of a drab marlyte, effervescence marked after a short time in cold HCl. A few chips of greenish, argillaceous shale.	
	2138′.	Bottom of well. Drillers log " tools drawn 3′ below base of salt bed."	Onondaga Salt group.

Diagrammatic Section of the Kerr Well at Rock Glen, New York.

Approximate altitude 1306′ A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.	
	95′	Drift; clay and gravel.	
95′	——	Rock, sandstone and shale.	
	455′	Portage.	
550′	----	Blackish shale, top of Genesee (?).	
	100′	Genesee.	
650′	----?	Base of Genesee.	
	750′	Limestone at 1100′. Hamilton.	
1400′	——		
	50′	Marcellus.	
1450′	——		
	140′	Upper Helderberg.	
1590′	----?	Base of Upper Helderberg.	
		Lower Helderberg.	
	310′		
		Dark gray magnesian limestone at 1700′.	Onondaga Salt group.
1900′	----		
	130′	Greenish and brownish-red marlytes.	
2030′	----		
	15′	1st rock salt stratum.	
2045′	----		
	40′	Greenish-gray marlyte.	
2085′	----		
	50′	2d rock salt stratum.	
2135′	----		
2138′	——	Drab marlyte.	
		Bottom of well.	

Since the Kerr well is located in the Warsaw salt basin the preceding section will serve as a standard one for the rocks of that region, through which so many wells have been and will be drilled in order to reach the beds of rock salt. A number of wells have been drilled at this locality ([1]) and the above section agrees fairly well with the one reported by Professor Bishop, ([2]) which is given below for the purpose of comparison.

(1.) See Ann. Rept. Supt. Onondaga Salt Springs for 1888, p. 19.

(2.) 5th Ann. Rept. State Geologist [of New York] for 1885, p. 24. This section is copied by Dr. Engelhardt, *ibid.*, chart No. II.

SECTION OF ROCK GLEN WELL.

Compiled from data given by Professor Bishop.

Altitude 1310′ A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	128½′	"Soil."	
128½′	——		Portage.
	1361½′	"Sandstone and shale."	Genesee. Hamilton.
1490′	——		Marcellus.
	140′	"Corniferous limestone."	Upper Helderberg.
1630′	——		Lower Helderberg.
	385′	"Lower Helderberg."	Onondaga Salt group.
2015′	——		
	25′	"Salt."	
2040′	——		
	31′	"Shale."	
2071′	——		
	40′	"Salt."	
2011′	——	Bottom of well.	

At Warsaw, nine miles NNW of Castile, several wells have been drilled on the western side of the valley. Of the considerable number of wells drilled near Warsaw, one of the best for our purpose is the Gouinlock and Humphrey well (formerly called Humphrey-Stedman), which is located a short distance north of the "Erie" station and is reported by the driller, Mr. Thos. Percy, as two feet lower than the R. R. track, which would give an altitude of 1324′ for the mouth of the well. This well is mentioned in a general way by Dr. Engelhardt, (1) while Professor Bishop gives a partial record of the well, which was much more complete after the salt was reached giving the thickness of the different layers of salt and shale (2). These data have been supplemented by information furnished by Mr. Percy, which was kindly given me by Dr. H. S. Williams, and also by notes sent me by Dr. W. C. Gouinlock.

(1.) Ann. Rept. Supt. Onondaga Salt Springs, for 1888, p. 18.
(2.) 5th Ann. Rept. State Geologist [of New York] for 1885, p. 23.

Section of Gouinlock and Humphrey Well, near "Erie" Station, at Warsaw, N. Y.

Altitude 1324′ A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	12′	Drift.	
12′	----		
	1218′		Portage. Genesee. Hamilton.
1230′	——	Marcellus, "about 40′."	
	150′	"Corniferous limestone."	Upper Helderberg.
1380′	——		Lower Helderberg.
	60′	"50′—60′ soft shale."	Onondaga Salt group.
1440′	----	2d limestone.	
		"200′—250′ softer than Corniferous, but drills hard."	
1800′	----	"Indications of rock salt."	
1803′	----	Rock salt. (1)	
	19′	"Salt and shale."	
1822′	----		
	3′	Salt.	
1825′	----		
	12′	Salt and shale.	
1837′	----		
	24′	Salt.	
1861′	----		
	2′	Shale with a little salt.	
1863′	----		
	16′	Salt.	
1879′	——	Bottom of well.	

On the eastern side of the valley, along the line of the Buffalo, Rochester and Pittsburgh Railway, are a considerable number of salt wells, and the records of several of them will be of value for our purpose. About ten rods from the station of the B., R. & P. R. R. is one of the Gouinlock and Humphrey wells.

(1.) There is a slight difference in the record of the lower portion of this well as reported by Professor Bishop and Dr. Gouinlock and that furnished by Mr. Percy. Bishop and Gouinlock report that salt was reached at a depth of 1803′ and that the well was drilled 76′ deeper, making its total depth 1879′. Mr. Percy's notes give the depth at which salt was reached as 1807′ and then state that it was drilled 84′ deeper, making it 12′ deeper than the other record, or with a total depth of 1891′.

SECTION OF GOUINLOCK AND HUMPHREY WELL, NEAR B., R. & P. R. R. STATION AT WARSAW, N. Y. (1)

Approximate altitude 1125′ A. T. (2)

DEPTH.	THICK-NESS.	KIND OF ROCK.	FORMATION.
	17′	Clay.	
17′	----		
	1011′	"Shales."	Portage. Genesee. Hamilton. Marcellus.
1028′	----		
	148′	"Corniferous limestone."	Upper Helderberg.
1176′	----		Lower Helderberg.
	75′	"Shales."	Onondaga Salt group.
1251′	----		
	300′	Limestones.	
1551′	----		
	45′	"Shale."	
1596′	----		
	37′	"Salt and shale mixed."	
1633′	----		
	68′	"Main salt bed."	
1701′	----	Bottom of well. (3)	

The Warsaw Salt Co. has six wells about one half mile north of the B., R. & P. R. R. station. The records of two of these wells are given by Professor Bishop. It is stated that they "vary slightly in depth owing to difference of elevation of the place where the well was begun," (4) and the following section is compiled from the record of the well which is reported with greater fullness :

(1.) Compiled from data given by Prof. Bishop (5th Ann. Rept. State Geologist [of New York] for 1885, p. 22) and Dr. H. S. Williams.

(2.) Dr. Engelhardt gives the elevation as 1,125′ (Ann. Rept. Supt. Onondaga Salt Springs for 1888, chart No. III).
Prof. Williams says "mouth about level with depot," and Gannett gives the elevation of the railroad as 1117′ (Bull. U. S. Geol. Surv., No. 76, p. 370).

(3.) Mr. I. Wm. Smith of Syracuse, N. Y., has furnished me the following section of the above well :

Surface earth	8′
Slate or shale	1020′
Hard rock	150′
Limestone, &c	456′
Salt rock	68′

Dr. Gouinlock mentions a second well, owned by the same company, which is 1745′ in depth.

(4.) 5th Ann. Rept. State Geologist [of New York] for 1885, p. 22.

Section of Warsaw Salt Company's Well, ½ mile north of B., R. & P. R. R. Station at Warsaw, N. Y.

Approximate altitude 1190′ A. T.(1)

Depth.	Thickness.	Kind of Rock.	Formation.
	16′	Clay.	
16′	----		
	940′	Shale.	Portage. Genesee. Hamilton. Marcellus.
956′	——		
	156′	"Corniferous limestone."	Upper Helderberg.
1112′	----		Lower Helderberg.
	430′	Limestone and shale.	Onondaga Salt group.
1542′	----		
	30′	"Shale and salt mixed."	
1572′	----		
	6′	1st salt stratum.	
1578′	----		
	6′	Shale. (2)	
1584′	----		
	70′	2d salt stratum.	
1654′	----	Bottom of well. (3)	

(1.) Ann. Rept. Supt. Onondaga Salt Springs for 1888, chart No. III.

(2.) Dr. Engelhardt gives the thickness of the last layer of shale as 10′ instead of 6′, which makes a total depth of 1658′ (*Ibid.*, chart No. II.) It is also stated that these wells have "an average depth of 1650 feet and seventy-five feet of rock salt in several layers, with shale between" (*Ibid.*, p. 18).

(3.) In Well No. 4 of this company, salt was reached at 1510′ and the total depth of the well is 1621′ (5th Ann. Rept. State Geologist [of New York] for 1885, p. 22).

Mr. I. W. Smith of Syracuse, kindly gave me the following record of another well of the Warsaw Salt Co. (formerly known as the Wing and Evans), which is stated to be near the above well.

Depth.	Thickness.	Kind of Rock.	Formation.
	17′	Clay.	
17′	——		
	956′	Shale.	Portage. Genesee. Hamilton. Marcellus.
973′	——	Corniferous limestone.	Upper Helderberg.
	148′		Lower Helderberg.
1121′	——		
	71′	"Flint."	Onondaga Salt group.
1192′	——		
	354′	Limestone.	
1546′	——		
	90′	Shale and Salt.	
1636′	——		
	64′	Rock salt.	
1700′	——	Bottom of well.	

In October, 1890, Dr. W. C. Gouinlock wrote me as follows in reference to the wells of the Warsaw salt district : "The rocks drilled through in all the wells are similar. The rock salt dips to the southwest 40' to the mile and the surface rises several hundred feet from Pearl Creek to Rock Glen (the Kerr Salt Works). The Corniferous limestone comes to the surface at Le Roy, and the same rock at the B., R. & P. R. R. station [Warsaw] is 1028' down. The salt lies pretty uniformly at 530' to 550' below this rock. The difference in the depth of the wells is always the surface difference above the Corniferous limestone, or 'hard rock' as the drillers call it. The salt strata are about 80' in thickness."

About one mile north of the B., R. & P. R. R. station at Warsaw, on the lower side of the track, is the well of the Standard Salt Co., a section of which is as follows :

SECTION OF THE STANDARD SALT COMPANY'S WELL.

Approximate Altitude 1045' A. T. (1)

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	26'	Clay.	
26'	----		
	874'	Shale.	Lower Portage. Genesee. Hamilton. Marcellus.
900'	——		Upper Helderberg.
	148'	Corniferous limestone.	Lower Helderberg.
1048'	----		Onondaga Salt group.
	457'	Limestone ; shale with salt at bottom. (2) 1st salt at 1488'.	
1505'	----		
	40'	Rock salt.	
1545'	----		
	104'	Red shale or sandstone. (3)	
1649'	----	Bottom of well.	

(1.) Ann. Report Supt. Onondaga Salt Springs for 1888, chart No. III.

(2.) Prof. Bishop gives the "limestone, shale and salt" as 40' and the "rock salt" as 457'. It is evident that there is a mistake in this portion of the section; but a record of the same well communicated to me by Mr. Smith gives the section as above, so it is quite clear that the printer transposed the figures in Prof. Bishop's section (5th Ann. Rept. State Geologist [of New York] for 1885, p. 21). Dr. Engelhardt gives the "limestone, shale and salt" as 440' and the "rock salt" as 57', (Ann. Rept. Supt. Onondaga Salt Springs for 1888, chart No. II); while on p. 18 it is stated that the

Thirty rods north of the Standard well, on the eastern side of the railroad are the two wells of the Miller Salt Co. The following section of one of these wells is compiled from data given by Professor Bishop. (1)

SECTION OF THE MILLER SALT COMPANY'S WELL.

Approximate altitude 1085′ A. T. (2)

DEPTH.	THICKNESS	KIND OF ROCK.	FORMATION
	935′	Shale.	Lower Portage. Genesee. Hamilton. Marcellus.
935′	——		
	147′	"Corniferous limestone."	Upper Helderberg.
1082′	----		Lower Helderberg.
	12′	Shale.	Onondaga Salt group.
1094′	----		
	400′	Limestone.	
1494′	----		
	30′	Shale and salt.	
1524′	----		
	85′	Rock salt. (3)	
1609′	----	Bottom of well.	

At Saltvale, about three miles north of Warsaw or three miles south of Wyoming, are the two wells of the Crystal Salt Co. Professor Bishop gives the following section of well No. 1 : (4)

well is "1,650 feet in depth, with a salt vein of only twenty-seven feet thickness." On chart No. III the first salt is given as 1488′. In data obtained by Prof. Williams about this well the Corniferous limestone is given as 900′, first salt as 1505′ and bottom of salt as 1574′.

(3.) It will be noticed that this well shows the presence of the red shales of the Onondaga Salt group, below the salt horizon. Prof. Hall did not find surface exposures of this shale in western New York and wrote "the red shale forming the *lower* division of the group [Onondaga Salt group] * * * I have not been able to find west of the Genesee river."

"West of the Genesee * * * * the red shale has either thinned out or lost its color, gradually becoming a bluish green; while otherwise the lithological character remains the same" (Geol. of N. Y., Pt. IV, p. 119).

Farther west in Ontario the red shales are present in the lower part of the Onondaga Salt group as was described by Dr. T. Sterry Hunt, who stated that the lower strata "consisted chiefly of reddish and bluish shales, with inter-stratified beds of gypsum" (Am. Jour. Science, 2d ser., Vol. xlvi, (1868) p. 359). The probable occurrence of the red shales near Chippawa village, Ontario, and on the Welland canal, near Port Robinson, was inferred by Sir Wm. Logan, from the fact that "the clay for a considerable extent in that neighborhood, has a red color, such as might be expected from the disintegration of the red shales, which occur at the base of the formation in New York" (Geol. Surv. Canada. Rept. of Prog. from its commencement to 1863, p. 347).

(1.) 5th Ann. Rept. State Geologist [of New York] for 1885, p. 21.

(2.) Ann. Rept. Supt. Onondaga Salt Springs for 1888, Chart No. III.

(3.) Dr. Engelhardt says, "The Miller salt works obtain their brine from two wells of about 1,600 feet depth with nearly 100 feet of a rock salt vein in one, and less than a fifty-foot vein in the other, though the wells are only a short distance apart" (*ibid.*, p. 18); but on Chart No. II. Prof. Bishop's section is given without modification.

(4.) 5th Ann. Rept. State Geologist [of New York] for 1885, p. 21.

SECTION OF THE CRYSTAL SALT COMPANY'S WELL.

Approximate altitude 980′ A. T. (1)

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	136′	Sand and gravel.	
136′	----		
	634′	Shale.	Genesee. Hamilton. Marcellus.
770′	——		
	146′	"Corniferous limestone."	Upper Helderberg.
916′	----		Lower Helderberg.
	15′	Shale.	Onondaga Salt group.
931′	----		
	394′	Limestone.	
1325′	----		
	50′	Salt and shale.	
1375′	----		
	61′	Rock salt.	
1436′	——	Bottom of well.	

One mile south of Wyoming on the western side of the valley is the "Pioneer" salt well, in which rock salt was first found in New York state in 1878. A section of this well was published by Dr. Engelhardt in 1882. (2) The section is repeated in the report of the following year and again in 1889. There are slight variations in the three accounts of this well ; but in the main the last report has been followed in the compilation of the section given below :

(1.) Ann. Rept. Supt. Onondaga Salt springs for 1888, Chart No. III.

(2.) Ann. Rept. Supt. Onondaga Salt Springs for 1881, Assem. Doc. for 1882, No. 16, p. 20. Prof. Bishop states that a section of this well was published by Mr. Jas. Macfarlane in the *Syracuse* [*N. Y.*] *Journal*, in the latter part of July, 1878 (5th Ann. Rept. State Geologist [of New York] for 1885, p. 21).

Section of the First or "Pioneer" Wyoming Well.

Approximate altitude 1004′ A. T. (1)

Depth.	Thickness.	Kind of Rock.	Formation.
	40′	Soil and clay.	
40′	----		
	40′	Bluish shales.	Portage. (?)
80′	----		
	220′	Black shales becoming lighter below.	Genesee.
300′	----		
	10′	Limestone.	Hamilton.
310′	----		
	363′	Light colored shale and very black near the base.	Marcellus.
673′	——		Upper Helderberg.
	100′	Corniferous limestone.	Lower Helderberg.
773′	----		Onondaga Salt group. (773′–1530′)
	92′	Limestone.	
865′	----		
	405′	Drab colored limestone and gypseous shales.	
1270′	----		
	70′	Salt alternating with shale.	
1340′	----		
	190′	Red shales alternating with drab and dark colored shales. (2)	
1530′	——	Bottom of well.	

(1.) Ann. Rept. Supt. Onondaga Salt Springs for 1888, Chart No. III.

(2.) The thickness of the layers in the above section is taken from Chart No. II of Engelhardt's report for 1888, but the description is in part from his earlier accounts. In the first account the thickness of the "shales alternating with gypsum and limestone," just above the salt, is given as 362′ instead of 405′ (Ann. Rept. Supt. Onondaga Salt Springs for 1881, p. 20). The account the following year gives the Hamilton limestone as 5′ thick instead of 10′; the shales below this limestone as 345′ instead of 363′; from the top of the Corniferous limestone to the top of the salt as 610′ instead of 597′; and the red shales as 200′ instead of 190′ (*Ibid.*, 1882, Assem. Doc. for 1883, No. 35, p. 25). The section quoted by Professor Bishop gives it as 660′ from the mouth of the well to the top of the Corniferous limestone instead of 673′; and from the top of the limestone to the salt as 610′ instead of 597′ (5th Ann. Rept, State Geologist [of New York] for 1885, p. 21).

Mr. James Macfarlane, in his account of this well, stated that the salt was reached at a depth of 1279′; that it was 70′ thick, of which 40′ or 50′ consisted of pure salt; then the well was continued to a depth of 1530′ through red shales and sandstones of the salt group; and that the Niagara limestone was reached at 1562′ (Am. Jour. Science, 3d ser., Vol. xvi, 1878, p. 144).

In the village of Wyoming is the well of the Globe Salt Company. The surface rock is stated by Professor Bishop to be Genesee shale. ([1])

SECTION OF THE GLOBE SALT COMPANY'S WELL.

Approximate altitude 958′ A. T. ([2])

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	1220′		Genesee. Hamilton. Marcellus. Upper Helderberg. Lower Helderberg.
1220′	----		Onondaga Salt group.
	20′	Salt and shale mixed.	
1240′	----		
	81′	Rock salt.	
1321′	----	Bottom of well.	

One mile north of Wyoming, near the track of the B., R. & P. R. R., is the Moulton well.

SECTION OF THE MOULTON WELL.

Approximate altitude 925′ A. T. ([3])

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	3′	Soil.	
3′	----		
	552′	Arenaceous and argillaceous shales.	Hamilton. Marcellus.
555′	——		
	152′	Corniferous limestone.	Upper Helderberg.
707′	----		Lower Helderberg.

(1.) *Ibid.*, p. 20, and the data for the above section are also given on p. 20.
(2.) Ann. Rept. Supt. Onondaga Salt Springs for 1888, Chart No. III.
(3.) *Ibid.*, Chart No. III.

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	60′	Shale.	Onondaga Salt group.
767′	----		
	323′	Limestone.	
1090′	----		
	34′	Shale.	
1124′	----		
	27′	Shale and salt.	
1151′	----		
	85′	Rock salt.	
1236′	----		
	5′	Shale.	
1241′	——	Bottom of well. (1)	

At Pearl Creek, nine miles north of Warsaw or three miles north of Wyoming, are two wells. Their approximate altitude is 952′ A. T. (2); one is 1194′ deep with 20′ of rock salt and the other 1182′ deep with 25′ of rock salt. (3)

A well was drilled four miles south of Le Roy at the junction of the B., R. & P. R. R. with the D., L. & W. R. R., which gave the following section.

Section of Well Four Miles South of Le Roy.

Approximate altitude 925′ A. T. (4)

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	46′	Gravel.	
46′	----		Hamilton.
	192′	Shale.	Marcellus.
238′	——		
	146′	Corniferous limestone.	Upper Helderberg.
384′	----		Lower Helderberg.
	454′	Limestone.	Onondaga Salt group.
838′	----		
	40′	Rock salt.	
878′	——	Bottom of well. (5)	

(1.) The section is compiled from data given by Prof. Bishop (5th Ann. Rept. State Geologist [of New York] for 1885, p. 20). The same section is copied by Dr. Engelhardt (Ann. Rept. Supt. Onondaga Salt Springs for 1888, Chart No. II).

(2.) *Ibid.*, Chart No. III.

(3.) *Ibid.*, p. 17.

(4.) *Ibid.*, Chart No. III.

(5.) Section compiled from data given by Prof. Bishop (5th Ann. Rept. State Geologist [of New York] for 1885, p. 20). The section is copied by Dr. Engelhardt without change (Ann. Rept. Supt. Onondaga Salt Springs for 1888, Chart No. II); but on Chart No. IV 7′ of shale is given below the salt, making the total depth 885′.

SECTION OF WELL NO. 2 AT LE ROY, NEW YORK, EIGHTEEN MILES NORTH OF WARSAW.

Approximate altitude 863′ A. T. (1)

DEPTH.	THICKNESS.	KIND OF ROCK.	FORMATION.
	22′	Soil.	
22′	----		
	11′	Marcellus shale.	
33′	——		
	137′	Corniferous limestone.	Upper Helderberg.
170′	----		Lower Helderberg.
	440′	Limestone and shales.	Salt group. Onondaga
610′	----	Brine in shale mixed with salt.	
	380′		
990′	——	Niagara limestone and bottom of well. (2)	

In the latter part of 1887 a well was drilled at Batavia, ten miles west of Le Roy, and through the kindness of Mr. D. L. Dodgson of that town, a set of samples was obtained for examination. The well is located south of the village on the bank of Tonawanda creek and is reported as six feet lower than the station of the N. Y. Central & Hudson River R. R. According to Gannett the elevation of the Batavia station is 895′ A. T., (3) which would make the mouth of the Batavia well 889′ A. T.

DETAILED RECORD OF THE BATAVIA WELL, AT BATAVIA, GENESEE CO., NEW YORK.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.
1.	40′.	Black, argillaceous shale, with dark brown streak ; one chip with iron pyrites. Marcellus.
2.	100′.	Mainly light gray limestone chips ; but with some dark gray. Strong effervescence in cold HCl. Upper Helderberg.
3.	150′.	Mainly dark gray limestone mixed with chert ; some light gray chips. (4)

(1.) *Ibid.*, Chart No. III.

(2.) The section is compiled from data published by Prof. Bishop (5th Ann. Rept. State Geologist [of New York] for 1885, p. 19).

(3.) Bull. U. S. Geol. Surv., No. 76, p. 43.

(4.) Prof. Hall noted the large amount of hornstone in the surface exposures of the Corniferous limestone in the vicinity of Le Roy (Geol. N. Y., Pt. IV, pp. 166, 167, see especially the section along Allen creek below Le Roy).

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.
4.	200′.	Mostly light gray limestone and chert; some of the dark gray chips.
5.	250′.	Drab colored limestone, moderate effervescence in cold HCl; lithologic character quite different from No. 4. Waterlime or upper Onondaga Salt group. (1)
6.	300′.	Dark gray chips which effervesce very slowly in cold HCl, increased by heating, leaves large residue.
7.	350′.	Dark gray, somewhat calcareous chips. Effervescence increased by heating.
8.	400′.	Ditto, only rather more calcareous.
9.	450′.	Dark gray to slightly greenish-gray argillaceous shales. Slightly calcareous.
10.	550′.	Dark gray chips, about the same as No. 8, more calcareous than No. 9.
11.	600′.	Grayish, somewhat calcareous chips mixed with crystals of rock salt. Mr. Dodgson reported about 15′ of salt.
12.	650′.	Greenish-gray shale, some very slightly pinkish. No effervescence in cold HCl. Mr. Dodgson reported red shale at about 650′, but only 6′–8′ in thickness with indications of salt.
13.	700′.	Greenish-gray with some slightly purplish chips. Some effervescence in cold HCl. Fragments of gypsum.
14.	750′.	Dark gray limestone, effervescence moderately strong in cold HCl, after a few minutes. Some of the chips show spots of resinous lustre as was described by Professor Hall in 1843. (2)
15.	800′.	Ditto, nearly all the chips have a resinous lustre. (3)
16.	840′.	Dull gray to drab chips which are very fine.
17.	900′.	About the same as No. 16.

(1.) It is difficult in well samples to decide where the Upper Helderberg stops and the Onondaga Salt group commences (see Harris, Amer. Geol., Vol. VII, p. 170); but of these samples No. 4 is characteristic of the Upper Helderberg and No. 5 of the upper Onondaga Salt group.

(2.) Geol. of N. Y., Pt. IV, p. 85.

(3.) Sample No. 14, is a dark gray limestone which seems to be near the character of the Niagara; but No. 15, which is not quite so dark in color, must be Niagara. Prof. Hall says: "The lithological characters alone of the two upper divisions [of the Niagara] are everywhere sufficient to distinguish this part of the rock from all other limestones in the State; these are, its brittle nature, the glistening surface of the minute crystalline laminæ of which the mass is composed, and its harsh or apparently siliceous character" (Geol. N. Y., Pt. IV, p. 87). In No. 15 is a large chip on which the glistening laminæ are very conspicuous, they are also noticeable on the largest chips of No. 14.

NO. OF SAMPLE.	DEPTH.	DESCRIPTION OF SAMPLE.
18.	1000'.	Dark gray to bluish-gray argillaceous shale, non-calcareous. (1)
19.	1100'.	Red argillaceous and finely arenaceous chips. Medina.
20.	1200'.	Pure quartz sandstone, slight reddish tint ; 70' in thickness.
21.	1650'.	Dark red (chocolate) finely arenaceous chips.
22.	2000'.	About the same as No. 21. Bottom of well still in the Medina.

DIAGRAMMATIC SECTION OF THE BATAVIA WELL, AT BATAVIA, NEW YORK.

Altitude 889' A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.
	40'	Drift.
40'	----	
	60'	Marcellus.
100'	——	
	150'	Upper Helderberg. Lower Helderberg.
250'	——	
	500'	About 15' rock salt at 600'. { Onondaga Salt group.
750'	----	? Top of Niagara limestone.
	250'	Niagara.
1000'	----	Clinton (?).
	100'	Probably mostly Medina. (2)
1100'	----	Medina.
	900'	
2000'	——	Bottom of well in Medina.

In the summer of 1883 a well was drilled at Brockport, about 16½ miles east of north from LeRoy, and an account of this well together with some samples was furnished by Mr. John H. Kingsbury.

(1.) It is very difficult to decide whether this sample ought to be referred to the Niagara or Clinton shale. Prof. Hall in 1852 called attention to the similarity of the lithologic characters of these two groups in western New York, when he wrote : "The lithologic characters of the Clinton and Niagara groups are so similar that they could well be united" (Geol. Surv. N. Y., Palæontology, Vol. II, p. 107). But from a comparison of other well records and samples it is probable that No. 18 is from near the bottom of the Clinton.

(2.) Sample No. 18 from 1000' is probably from near the base of the Clinton. The next sample No. 19 from 1100' is Medina and probably most of the 100' between samples Nos. 18 and 19 belongs to the Medina, which would give it a thickness of at least nearly 1000' in this well.

The mouth of the well must be near the top of the Medina, which outcrops at that locality. At 1200′ a slight flow of gas was obtained, which made a flame about ten inches in height from a ¾ inch gas pipe.

SECTION OF THE BROCKPORT WELL, AT BROCKPORT, MONROE CO., NEW YORK.

Altitude 538′ A. T. (1)

DEPTH.	THICKNESS.	KIND OF ROCK.	
		Medina.	Medina.
500′	----	Red shale.	
900′	----	Darker red shale.	
950′	----	Very dark red shale.	
1000′	——		
		Gray and bluish chips, about ¼ are light gray and slightly calcareous.	Hudson and Utica shale.
1400′	----	Blue shale and sandstone.	
2000′	——	Blue compact limestone.	
		Trenton and bottom of well.	

During the winter of 1890-91 a well was drilled at Rochester, about 22 miles northeast of Le Roy, by Messrs. Otis and Gorsline. Samples were saved which have been carefully studied by Professor H. L. Fairchild, who has very kindly furnished me with advance pages of his paper describing this well. (2)

SECTION OF THE ROCHESTER WELL, AT ROCHESTER, MONROE CO., NEW YORK, AS REPORTED BY PROFESSOR H. L. FAIRCHILD.

Altitude 506′ A. T.

DEPTH.	THICKNESS.	KIND OF ROCK.
	22′	Drift.
22′	----	
	228′	Niagara and Clinton.
250′	——	
	1158′	Medina—red 1075′— and Oswego or Oneida 83′. } 1158′.
1408′	——	

(1.) Engelhardt. Rept. Supt. Onondaga Salt Springs for 1888, p. 16, Chart No. III.

(2.) A Section of the Strata at Rochester, N. Y., as shown by a deep boring. Proc. Rochester Academy of Science, Vol. I, pp. 182–186. The section of the well is given on pp. 183, 184.

A duplicate set of samples of the Rochester well was presented to the National Museum by Professor Fairchild and these specimens have been studied by the writer, who cordially agrees with Professor Fairchild's interpretation of the record.

DEPTH.	THICKNESS.	FORMATION.
	598′	Hudson and Utica. (1)
2006′		
	954′	Trenton.
2960′		
	137′	Calciferous (?).
3097′		
	3′	Archean (?).*
3100′		Bottom of well.

Professor Fairchild writes: "No allowance is here made for errors in measurement by the drillers. I think that eleven feet should be taken from the Niagara and added to the Medina making the latter 1169 feet thick." (Letter of October 6, 1891).

From the preceding well sections, a general section has been compiled giving the approximate thickness of the different formations, together with the total thickness from the Olean conglomerate (?)

(1.) Sample No. 34, at 1818′ is a dark blue argillaceous shale which in lithologic characters resembles the Utica shale. But, the next sample, No. 35 from 1868′, is a bluish shale like the Hudson above. Sample No. 36, at 1912′, is undoubtedly Utica and No. 37 from 1928′ is likewise a dark blue argillaceous shale.

(*) [NOTE.—The following letters to Professor H. L. Fairchild from Professor J. E. Wolff, Instructor in Petrology at Harvard University, concerning the petrographical examination of the samples of rock from the Rochester well, supposed to be Archean, are self explanatory, and this seems to be the most appropriate place for their insertion. For the original article by Professor Fairchild describing the samples from this well see Vol. I of the Proceedings, pp. 182–186. *Ed.*

CAMBRIDGE, MASS., April 21, 1892.

DEAR PROF. FAIRCHILD:—I have had a number of thin sections prepared of the material you sent me from the Rochester deep well with the following results:

Sample 62 in slides. The fragments of shale are microscopically composed of small rounded grains of quartz, more angular ones of feldspar, (both orthoclase, plagioclase, microcline, and microperthite) and a cement stained yellow by iron hydrate, apparently composed of a micaceous element with some calcite. Some of the fragments are of a fine-grained limestone.

Sample 63 in slides. Sample in grains effervesces with cold conc. HCl, strongly if warmed. Fragments of fine-grained limestone, often containing round grains of quartz of larger size than the calcite grains; also fragments of loose quartz, part of which have certainly been broken out of the above limestone. There are also fragments of the same fine-grained grit or shale as in 62, very feldspathic. There is one large fragment of microperthite (intergrowth of two feldspars characteristic of Laurentian gneisses) and also one fragment of a rather fine-grained gneiss composed of microcline and quartz. The last two fragments are undoubtedly from the Archean gneiss, but of course might have come from pebbles in the basement rock resting on the Archean. Also fragments of calcareous quartzite composed of rounded grains of quartz with a calcareous cement.

Sample 64 is composed of pure quartz grains, ferruginous and masses of limonite. Occasionally a grain of microcline or other feldspar.

The points that strike me are that in sample 63 the limestone contains frequent large apparently clastic grains of quartz and that the quartzite is also calcareous. This is the character of the Cambrian (Stockbridge) limestone at Rutland, Vt., in proximity to the underlying Olenellus quartzite. The fragments of feldspar from the Archean and of fragments of gneiss suggest close proximity to the Archean at least. That both in this and 64 there should be so little feldspar comparatively makes me doubt whether these come actually from gneiss, the hornblende or mica might be supposed to have floated off, but there ought to be more feldspar. It would look more like a feldspathic quartzite very close to gneiss. * * * * Yours very truly, J. E. WOLFF.

CAMBRIDGE, MASS., May 6, 1892.

DEAR PROF. FAIRCHILD:—In reply to your letter of April 29th, the sample 63, which I have, effervesces gently with cold concentrated HCl, and violently when slightly warmed, showing a dolomitic tendency. The microscopic description shows that there are grains of calcareous quartzite, quartz-bearing limestone or dolomite, and fine-grained grit or shale, so that it is a mixture of fragments of three kinds besides the feldspar and gneiss. You are welcome to make any use you can of these microscopic determinations although they do not seem decisive enough to have great weight in the question whether or not the Archean was struck. * * * * Yours very truly, J. E. WOLFF.]

down to the Archean (?). With two exceptions the thickness of each formation is obtained from some well record and the wells which have furnished most of the data for this general section are the Clarksville, Castile, Rock Glen, Batavia and Rochester.

A General Geological Section of Western New York, not far west of the Genesee River.

DEPTH.	THICKNESS.	FORMATION.
0′	——	Little Genesee conglomerate = Olean conglomerate (?).
	300′	Upper Devonian (estimated).
300′	----	Wolf creek conglomerate.
	1150′+	Chemung. (1)
1450′+	----	
	900′	Portage (estimated in part). (2)
2350′	----	
	100′	Genesee shale. (3)
2450′	----	
	750′	Hamilton.
3200′	——	
	50′	Marcellus shale.
3250′	——	
	150′	Upper Helderberg and ? Lower Helderberg. (4)
3400′	——	
	600′	Onondaga Salt group. (5)
4000′	——	
	250′+	Niagara and Clinton.
4250′+	——	

(1.) It is probable that the Clarksville well, No. 91, does not reach the bottom of the Chemung and in that case 1150′ is not the entire thickness of this stage.

(2.) From a comparison of the well sections there was about 825′ of Portage in the Castile well. But that well did not commence at the top of the Portage, so that it is better to call this stage at least 900′ in thickness and it may be considerably thicker.

(3.) The first black shale seen may not be the top of the Genesee, but some of the black bands in the lower part of the Portage, in which case 100′ is probably greater than the true thickness of the Genesee shale.

(4.) There is from 140′-150′ of rock that lithologically it is not possible to separate from the Upper Helderberg; but it is possible that part of this limestone ought to be referred to the Onondaga Salt group. Mr. Harris noted the same difficulty in the Jamestown well (Am. Geol. Vol. VII, p. 170).

(5.) The wells throughout the salt district indicate a thickness of from 500′ to a little more than 600′ for the Onondaga Salt group.

DEPTH.	THICKNESS.	FORMATION.
	1158′	Medina, including 83′ of Oswego sandstone.
5408′	——	
	598′	Hudson and Utica.
6006′	——	
	954′	Trenton.
6960′	——	
	137′	Calciferous (?).
7097′	——	
	3′	Archean (?).
7100′	——	

In order to show the variation of the above section from our previous knowledge of the thickness of these terranes, a general geological section ranging through the same series of formations has been compiled from books and geological articles. In the compilation of this section the maximum thickness of the terranes, as near the line of section as possible, has been taken. The notes following the section give the authority and reference to the work in which may be found the statement of the thickness of the various terranes.

A Generalized Geological Section along the Genesee River, from the Olean Conglomerate to the Archean of Ontario,

Compiled from various books and articles.

DEPTH.	THICKNESS.	FORMATION.
0′	——	Olean conglomerate (Little Genesee conglomerate?).
	300′ (*a.*)	Upper Devonian.
300′	——	Wolf creek conglomerate (flat pebble).
	1500′ (?) (*b.*)	Chemung.
1800′	——	
	1000′ (*c.*)	Portage.
2800′	——	
	90′ (*d.*)	Genesee.
2890′	——	
	400′ (*e.*)	Hamilton.
3290′	——	
	50′ (*f.*)	Marcellus.
3340′	——	

DEPTH.	THICKNESS.	FORMATION.
	90′ (*g.*)	Upper Helderberg.
3430′		Place of Oriskany and Lower Helderberg.
	600′ (*h.*)	Waterlime and Onondaga Salt group.
4030′		
	180′ (*i.*)	Niagara.
4210′		
	80′ (*j.*)	Clinton.
4290′		
	700′ (*k.*)	Medina.
4990′		
	1030′(?) (*l.*)	Hudson and Utica.
6020′		
	750′ (*m.*)	Trenton.
6770′		
	40′ (*n.*)	Calciferous (?) and Potsdam (?).
6810′		
		Archean.

Authority and reference for the thickness of the terranes, as given in the preceding section.

a. Prof. Henry S. Williams stated that the distance between the little Genesee (Olean) and the Wolf creek (flat pebble) conglomerates "may average about 300′" (Bull. U. S. Geol. Surv., No. 41, p. 89). It is probable that Prof. Hall saw both the flat and angular pebble conglomerates, without distinguishing their different stratigraphical positions. He mentions a conglomerate "about three or four miles south of Wellsville" (4th An. Rept. Fourth Geol. Dist. N. Y., 1840, p. 409); again "in Scio it is found on the high grounds near the sources of some small streams flowing into the Allegany and Genesee," and finally "in the town of Genesee, about three miles north of the Pa. line, and near the center of that town, the conglomerate, essentially the same as at

Scio, occurs on the highest hills" (*Ibid.*, p. 410). The exposure last mentioned is probably the one called Little Genesee by Professor Williams and regarded as equivalent to the Olean conglomerate.

b. Professor Hall wrote: "The summit of the Portage group, on the Genesee river is less than 1200 feet above tide water. * * * * The highest hills toward the south part of the State are scarcely less than 2500 feet above tide water, showing a difference of elevation between the two groups of 1300 feet. Allowing for undulations, which render the dip irregular, the whole thickness is above 1500 feet" (Geol. N. Y., Pt. IV, p. 260). Since Professor Hall did not distinguish between the flat and the angular pebble conglomerates it is difficult to decide which of these conglomerates should be taken for the top of his Chemung. From certain statements we are inclined to think that the 1500′ was intended to represent the thickness of the rocks from the top of the Portage to the base of the Olean conglomerate. A comparison of Professor Hall's "Section from the mouth of the Genesee river to Instantur, Penn." and the "Vertical section showing the relative thickness of the different rocks" (2d An. Rept. Fourth Geol. Dist. N. Y., 1838) seems to indicate that then he considered the rocks from an "argillaceous iron ore" stratum near Wellsville, N. Y., down to "olive shale and sandstone" near Portage as 1750′ in thickness. These rocks correspond pretty closely with the limits of what Professor Hall later defined as the Chemung group of this region; but the thickness would be overestimated if it were based on the supposition that the dip amounted "to 50 or 60 feet in the mile" (*Ibid.*, p. 291).

Professor Williams' investigations seem to assign a thickness of between 1500′ and 1600′ to the rocks between the Wolf creek conglomerate and the top of the Portage sandstones. The altitude of the top of the Portage sandstone at Portage Falls is about 1200′ (Bull. U. S. Geol. Surv., No. 41, p. 52); altitude of Wolf creek conglomerate west of West Clarksville about 1950′ (*Ibid.* p. 86); hence 1950′—1200′=750′. The distance between the two places is about 33 miles which with a dip of 25′ to the mile (*Ibid.*, p. 103) would equal 825′. Then 750′+825′=1575′ for the thickness of that series of rocks.

Mr. Harris, by computation and the record of the Jamestown well, makes the thickness of the rocks from the Panama conglomerate to the Portage, all of which is Chemung, 1390′ (Am. Geol. Vol. VII, p. 165, pl. 4).

Prof. Hall wrote: "The thickness of this group [Portage] on the Genesee cannot be less than one thousand feet" (Geol. of N. Y., Pt. IV, p. 238, also, see p. 217). In 1840 Professor Hall gave the thickness of the Cashaqua shale (lower part of Portage) as 110′ (4th An. Rept. Fourth Geol. Dist. N. Y., p. 390), which is given as the same in the final report (*Op. cit.*, p. 227); but in the 4th An. Rept. the Gardeau (Middle Portage) and Portage sandstones (Upper Portage) are stated to "occupy a thickness of more than 1000 feet" (*Op. cit.*, p. 392), which makes the thickness of the entire Portage more than 1110′. The vertical section of 1838 gave a thickness of 500′ from the "olive shales and sandstones" down to "bituminous shales" (2d An. Rept. Fourth Geol. Dist. N. Y.); but this did not reach the base of the Portage and probably not its top as defined later. In 1879 it was given as "one thousand feet or more in central New York" (Geol. Surv. N. Y., Pal. Vol. V, Pt. II, p. 151).

Dr. Clarke in 1885 stated: "In Ontario County the entire series of Portage strata is very perfectly developed, reaching a thickness of between 800 and 1,000 feet" (Bull. U. S. Geol. Surv. No. 16, p. 36). This series is composed of about 365′ belonging to the Cashaqua and Gardeau subdivisions (*Ibid.*, pp. 36, 37), which are called Naples shales by Clarke, and about 600′ of Portage sandstones (*Ibid.*, p. 67, also, see p. 75). In the 4th An. Rept. of the [N. Y.] State Geologist for 1884, Dr. Clarke gave the thickness of the Naples shales in Ontario Co., as from "350—400 feet" (Assembly Doc. No. 161 for 1885, p. 20) and the Portage sandstones as from "600—700 feet" (*Ibid.*, p. 21).

Sir Wm. Logan in 1863 stated: "To the south of Lake Erie, in New York, * * * The Portage and Chemung sandstones have a thickness of 2,000 feet; which increases to 3,000, farther to the eastward" (Geol. Surv. of Canada, Rept. of Prog. from its commencement to 1863, p. 389). Mr. Harris assigns a thickness of 1315′ to the Portage in the Jamestown well (Am. Geol., Vol. VII, p. 174, pl. 4); which would make the combined thickness of the Chemung and Portage at least 2705′ for the Jamestown region and well (*Ibid.*, pp. 165, 174, pl. 4).

d. Hall's "vertical section" of 1838 gave 180′ of "bituminous shales containing septaria" in the vicinity of Mt. Morris (2d An. Rept. Fourth Geol. Dist. N. Y.) ; but this probably included the recurring black shales in the lower Portage. In 1839 the thickness of the upper Black shale (Genesee), in Seneca Co., was given as 150′ (3d An. Rept. Fourth Geol. Dist. N. Y., p. 301). While in the final report Professor Hall said : "On the shores of Seneca lake and in Ontario county the thickness of this rock is about 150 feet. * * * * After passing the Genesee river in a westerly direction, it soon becomes evident that the rock has diminished in thickness. * * * * On the shore of Lake Erie * * * [it] is but twenty-three feet seven inches" (Geol. N. Y., Pt. IV, p. 221). Dr. Clarke gives the thickness as 160′ along the shores of Canandaigua lake (Bull. U. S. Geol. Surv., No. 16, pp. 13, 14). With the thickness on Canandaigua lake 160′ and on Lake Erie nearly 24′, if the decrease in thickness were uniform then north of Warsaw the Genesee would be about 92′ thick. In the Jamestown well it is about 65′ (Harris, Am. Geol., Vol. VII, pl. 4 ; see p. 169).

e. The Tully limestone does not reach the Genesee river and consequently the next lower formation in this section is the Hamilton. Professor Hall wrote in 1839 : "The Tully limestone I have observed but at two points in Ontario county ; one in the bed of Flint creek at Bethel [now Gorham], * * * * the other four miles northwest of that village" (3d An. Rept. Fourth Geol. Dist. N. Y., p. 313). In the final report the Professor said : "On Canandaigua lake, it [Tully] is represented by a few inches of impure calcareous matter," and further : "This rock is virtually absent at all places west of Canandaigua lake" (Geol. N. Y., Pt. IV, p. 213). Dr. Clarke says : "This formation [Tully] is lacking in New York west of the village of Bethel, in the township of Gorham, but for a distance of ten or fifteen miles west of its last appearance its influence seems marked by the clearly defined separation between the shales of the Genesee and those of the underlying Hamilton" (Bull. U. S. Geol. Surv., No. 16, p. 17). Finally, in reference to the distribution of the Tully see the map of the "Geographical distribution of the Tully limestone, in central New York" by Prof. S. G. Williams in the Sixth An. Rept. State Geologist [N. Y.] for 1886 ; also, p. 14.

Prof. Hall on the "vertical section" of 1838 gave 400′ as belonging to the "Calcareous shales of the Mountain limestone;" but judging from the accompanying section along the Genesee river this division did not extend to the base of the Hamilton (2d An. Rept. Fourth Geol. Dist. N. Y.). In the final report the Professor gave its thickness on Lake Erie as less than 500′ and not less than 1000′ on the eastern limit of the fourth district, along Cayuga lake (Geol. N. Y., Pt. IV, p. 194). Dr. Clarke makes the thickness of the Hamilton in Ontario Co. probably greater than 400′ (Rept. State Geol. [N. Y.] for 1884, pp. 12–17). The Jamestown well has about 395′ of Hamilton (Harris, Am. Geol., Vol. VII, pl. 4, see pp. 169, 170).

f. Prof. Hall wrote: "The greatest thickness of this rock [Marcellus], where it can be measured accurately, does not amount to more than fifty feet" (Geol. N. Y., Pt. IV, p. 179). Dr. Clarke assigns it "a thickness of about 100 feet" in Ontario Co. (Rept. State Geol. [N. Y.] for 1884, p. 11). Mr. Harris calls it about 50′ thick in the Jamestown well (Am. Geol., Vol. VII, pl. 4, p. 170).

g. Hall's "vertical section" of 1838 gave a thickness of 350′ to what he then called the "Carboniferous or Mountain limestone" (2d An. Rept. Fourth Geol. Dist. N. Y., and see p. 307); but this apparently included the Marcellus and the base of the Hamilton. In 1843 the Professor considered "The point of greatest thickness [of the Corniferous limestone] actually measured is on Allen's creek [at Le Roy (?)], where it is seventy-one and a half feet" (Geol. N. Y., Pt. IV, p. 168). While the Onondaga limestone at Le Roy is possibly 20′ in thickness (*Ibid.*, p. 157). Prof. G. F. Wright gave the thickness of the Corniferous lime rock as 148′ in the shaft of the salt mine at Piffard Station, Livingston Co. (Science, Vol. VIII, p. 52). Dr. Clarke called the Upper Helderberg of Ontario Co. about 70′ in thickness (Rept. State Geol. [N. Y.] for 1884, p. 10). Mr. Harris reported about 150′ of Upper Helderberg in the Jamestown well (Am. Geol., Vol. VII, pl. 4, p. 170).

h. The Oriskany sandstone is scarcely represented in this section. Prof. Hall said: "In Monroe county, its only representative is a layer of greenish conglomerate about four inches thick. * * * The last place in the district where it has been noticed is in the bed of Black creek at Morganville in Genesee county" (Geol. N. Y., Pt. IV, p. 146). Dr. Clarke wrote: "it [Oriskany] is not known with certainty west of Manchester, Ontario Co." (Rept. State Geol. [N. Y.] for 1884, p. 10).

The presence of the Lower Helderberg limestone in this section also seems doubtful. The Waterlime or Hydraulic limestone of western New York was stated by Professor Hall to lie beneath the Lower Helderberg waterlime of eastern New York and he called it the fourth or upper division of the Onondaga Salt group (Geol. N. Y., Pt. IV, pp. 128, 129, 141 ; also, see sections 55 and 56 on p. 139). Dr. T. Sterry Hunt in describing the geology of the Ontario peninsula said : "Here are found non-fossiliferous strata, having the character of the so-called Waterlime beds, which belong to the summit of the Salina formation" (Am. Jour. Science, 2d ser. Vol. XLVI, 1868, p. 359). Professor Hall's map of 1874 giving the distribution of the Niagara and Lower Helderberg formations does not give any Lower Helderberg west of Ontario Co., while in the sections the "Water-lime formation" is given as intermediate between the Lower Helderberg and Onondaga Salt group (27th An. Rept. N. Y. State Mus. Nat. Hist., 1875, map, and see p. 128). The same position was assigned to the Water-lime by Professor Hall in 1859 (Geol. Surv. N. Y., Palæontology, Vol. III, Pt. I, Text, p. 385), although the author was inclined to refer it to the Onondaga Salt group (*Ibid.*, p. 387). The latter view is also taken by Dr. Clarke in 1889 (8th An. Rept. State Geol. [N. Y.] for 1888, p. 81). Finally, Ashburner stated : "The Buffalo cement bed [Water-lime of western N. Y.] is one of the top strata of the Salina, and does not belong to the Water-lime group [Lower Helderberg], as popularly supposed" (Trans. Am. Inst. Min. Eng., Vol. XVIII, 1890, p. 301. Also, see Ashburner in *ibid.*, Vol. XVII, p. 399, foot note †). On the contrary Professor Dana refers these beds to the Lower Helderberg (Man. of Geol., 3d ed., pp. 235, 236).

Hall's "vertical section" of 1838 assigned a thickness of 400′ to the "gypseous slates and marls," which agrees very closely with the limits of the Onondaga Salt group (2d An. Rept. Fourth Geol. Dist. N. Y.; also, see pp. 303–307 for a description of the rocks). Dr. Clarke gave the thickness of the Salina for Ontario Co. as "probably between 600 and 700 feet" (Rept. State Geol. [N. Y.] for 1884, p. 10). It thins slowly to the west, having a thickness of 475′ in the Buffalo well (Ashburner, Trans. Am. Inst. Min. Eng., Vol. XVII, p. 402). Professor Hall wrote Ashburner :

"My estimate of the prevailing thickness of the Salina formation on the west of the Genesee river is about 800 feet." But the Professor in the above estimate assigned too great a thickness to the red shale at the base of the group, which he says "may be 300 feet or more thick" (Trans. Am. Inst. Min. Eng., Vol. XVII, p. 400).

i. Prof. Hall, 1838, gave 150′ of "geodiferous and bituminous limestone" at Rochester and 110′ of "Calcareous shales" below (2d An. Rept. Fourth Geol. Dist. N. Y., vertical section and description of rocks on pp. 300–303). But the lower 18′ of the "calcareous shales" is the "upper limestone" of the Clinton, and it is not clear but that some of the Onondaga Salt group was included in the upper division. In 1843 the thickness of the Niagara shale at Rochester is given as about 100′ and the limestone as "about seventy or eighty feet at Rochester" (Geol. N. Y., Pt. IV., p. 97). Logan said: "At Rochester it [the Niagara] attains a thickness of about 180 feet" (Geol. Surv. of Canada. Rept. of Prog. from its commencement to 1863, p. 321).

j. The section of 1838 gave 61′ of "argillaceous shales, limestone, iron ore and green shale" to which 18′ of the overlying "calcareous shales" should be added, making 79′ of what was later named the Clinton (2d An. Rept. Fourth Geol. Dist. N. Y., vertical section; and see pp. 297–300 for a description of the rocks). In the final report the thickness of the Clinton on the Genesee river is stated to be 80′ 6″ (Geol. N. Y., Pt. IV, pp. 66, 67).

k. Hall's "vertical section" of 1838 gave a thickness of 300′ of "red marl and sandstone" along the Genesee river from Carthage to lake Ontario (2d An. Rept. Fourth Geol. Dist. N. Y., see pp. 294–297 for a description of the rocks). In 1843 the Professor reported its thickness along the Niagara river as about 350′, which he considered as probably less than half its thickness, and stated that it thinned to the eastward (Geol. N. Y., Pt. IV, p. 43). Logan thought that, apparently near Rochester, the entire thickness "of the formation [Medina] may be somewhat under 600 feet" (Geol. Surv. of Canada. Rept. of Prog. to 1863, p. 310).

l. Mr. Walcott reported 880′ of Lorraine sandstone and shales and 120′ of Utica shale in a well at Fulton, Oswego Co., N. Y., which he says "indicates a thickness of 1000 feet for the rocks of the Hudson period in northwestern New York" (Bull. Geol. Soc. Am., Vol. 1, p. 349). Prosser found that the Hudson period has a thickness of 1030′ in the well at Wolcott, Wayne Co., N. Y. (Am. Geol., Vol. VI, p. 204). Professor Hall stated : "The usual estimates of the thickness of this group [Hudson including Utica shale ; see Geol. Surv. N. Y., Palæontology, Vol III, Pt. 1, Text, p. 14] in central and northwestern New York are from 800 to 1000 feet" (*Ibid.*, p. 20, foot note). In the St. Catharines, Ontario, well, Ashburner reported the Hudson and Utica as 785′ in thickness (Trans. Am. Inst. Min. Eng., Vol. XVIII, p. 301). Logan gave the thickness of the Utica shale in Collingwood township, on Nottawasaga bay, at the head of Georgian bay, as "between fifty and a hundred feet" (Geol. Surv. of Canada. Rept. of Prog. to 1863, p. 211); and the Hudson as 770′ in thickness at the same locality (*Ibid.*, p. 213).

m. Sir Wm. Logan estimated the thickness of the Trenton along the Trent river in Ontario, which is nearly north of Rochester, as about 750′ (*Ibid.*, p. 188). Farther west he gave "about 150 feet for the Birdseye and Black River formation on lake Couchiching, and from 500 to 600 feet for the Trenton formation on lake Simcoe" (*Ibid.*, p. 193). The well at Wolcott passed through 750′ of Trenton without reaching its bottom (Prosser, Am. Geol. Vol. VI, p. 204) ; while its thickness in the St. Catharines well was 677′ (Ashburner, Trans. Am. Inst. Min. Eng., Vol. XVIII, p. 301).

n. Logan said there was no certain fossil evidence that the Calciferous occurred on the western side of the Laurentian ridge which crosses the St. Lawrence at the Thousand Islands (Geol. Surv. of Canada. Rept. of Prog. to 1863, p. 118). To the west of this region, Logan wrote : "No indication of the Potsdam formation has been observed in Canada, unless eight feet of red soft calcareous sandstone at Marmora [which is nearly north of Rochester], resting on the gneiss and succeeded by certain beds of limestone without observed fossils for thirty feet upwards, be supposed to represent it" (*Ibid.*, p. 100 ; also, see section on pp. 181, 182, where the base rests on "contorted Laurentian gneiss"). Ashburner states that the St Catharines well penetrates the Calciferous sandstone to the depth of 18′ (Trans. Am. Inst. Min. Eng., Vol. XVIII, p. 301).

Conclusion.

Taking the sum of these maximum estimates, we have a series of rocks 6810′ in thickness between the base of the Olean conglomerate and the top of the Archean (?). The same section compiled from a series of well records gives a thickness of 7100′. This is probably not a sufficient thickness for the entire section, since in the upper part of the series it is very probable that the Chemung is thicker than 1150′, and possibly the Portage may have a greater thickness than 900′. It is interesting to compare this section with Hall's of 1838 and note what change has occurred in fifty-three years. It is hardly possible to select a horizon in the upper part of the sections that is precisely equivalent; but it is thought that the stratum of "argillaceous iron ore" near Wellsville, at the top of the sub-division which was later called Chemung, is not far below the horizon of the Wolf creek conglomerate. The thickness of the series of rocks from this stratum down to the mouth of the Genesee river, according to Hall's section of 1838, is 4201′. The section compiled from well records, allowing the same thickness—300′—for the Medina on the Genesee river as in Hall's section, shows that the same series has a thickness of more than 4250′; but on account of our failure to yet obtain the exact thickness of the Chemung and Portage it can not be stated how much more than 4250′ the total thickness may be. In the section compiled from various sources of information this series has an estimated maximum thickness of 4290′. However, the comparison of the three sections shows that the early section of Professor Hall was carefully constructed and, when the development of the science at that time is taken into account, it reflects great credit upon the early work of the veteran geologist and paleontologist of New York state. The rocks above this "argillaceous iron ore" stratum up to the base of the lowest coal at Instantur, Pennsylvania, Professor Hall estimated to have a thickness of 1850′, making the thickness of the entire series from the base of the coal to the mouth of the Genesee river, 300′ down in the Medina, 6051′.

If this Genesee section be compared with the one of "Western Central New York" ([1]) it will be noticed that the probable thickness of the series agrees much more closely with the estimated maximum thickness than it did in the case of that section. This is due in a measure to the fact that for the upper and middle parts of the Genesee section the estimated thickness agrees better with the actual thick-

(1.) Am. Geol., Vol. VI, pp. 199-211.

ness than it did in the eastern section, and furthermore for the lower part of the section the published records of other wells have been used, which although at a considerable distance from the line of this section approximate nearer the actual thickness of these formations than do the earlier estimates. It is well to bear in mind the fact that the study of these well records is giving us more accurate knowledge of the thickness of the New York formations, so that any general section, carefully drawn up at present will be nearer the real thickness of the rocks than it could have been before any of these records were published. This point is brought out in a very clear manner by comparing the record of the Rochester well (1) with that of the Wolcott well, (2) forty-one miles east of Rochester. At Rochester, the thickness from the top of the Medina to the top of the Trenton is 1756′ and at Wolcott 1720′. It may be added that in both of these wells the top of the Medina as well as the top of the Trenton is sharply defined, so that there can be very little doubt as to the limits of this series of rocks. Leaving out of consideration all well records, a conservative estimate of the thickness of this series of rocks at Rochester, based on published data, would be from 1250′ to 1500′.

The following paper was read :

PRELIMINARY NOTICE OF THE DISCOVERY OF STRATA OF THE GUELPH FORMATION IN ROCHESTER, N. Y.

By Albert L. Arey, C. E.

In the southwestern part of this city on Frost Ave. and Summer street is Pike's quarry, the top rock covered by only two or three feet of soil is glaciated and nearly everywhere retains both the polish and the striæ left by the glacier. The rock contains very few fossils, near the top a few of the characteristic Corals and Sponges of the Niagara group—some ten feet below this crystals of Dolamite, Zinc blende, Galenite and Flour spar are abundant : at this level two or three fine Orthocerata and several specimens of Hall's so called Platystoma hemispherica have been found.

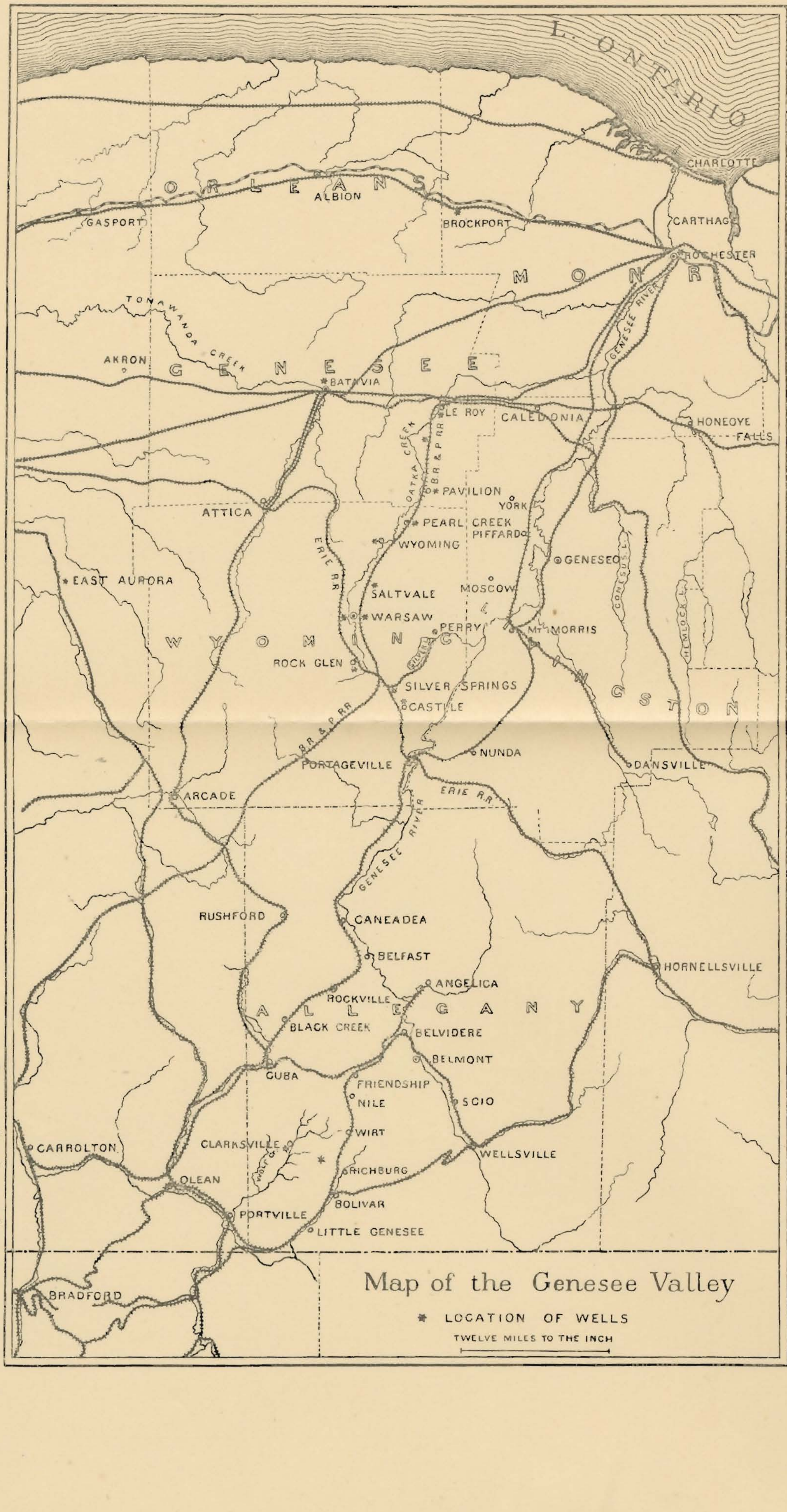
From a layer about twenty feet further down fine specimens of selenite and gypsum have been taken which greatly resemble those for which the Niagara of Lockport has so long been famous.

These qualities determine the rock, the typical Niagara limestone.

(1.) Fairchild, Proc. Rochester Acad. Sci., Vol. I, pp. 184, 186.

(2.) Prosser, Am. Geol., Vol. VI, p. 204.

[Pages 104–112 Printed Nov. 11, 1892.]



Map of the Genesee Valley

Five or six hundred feet southwest of Pike's quarry on a slight rise of ground is Nellis' lime kiln, where for forty or fifty years the upper two layers of rock have been burned, while those below have been sold as building stone. These upper layers each about two feet thick are a magnesian limestone, dark grey when freshly fractured but weathering to a light brown, they are badly broken but clearly in place and become particularly interesting on account of the great number of strange fossils which they contain.

Rocks resting on the New York Niagara limestone would be likely to represent Chicago and Racine beds, the much abused Guelph beds or a new formation, and in order to determine whether the new fauna corresponds with that of either of the above formations a study of the general characteristics of each fauna was made.

In the table which follows the numbers of species of each class found in various outcrops of rocks of the Niagara epoch are given.

The first column is based upon the collection which I have been able to make from these layers, the second column gives the number of Canadian Guelph species described in Vols. I. and III. Paleozoic Fossils also including those incorrectly attributed to the Onondaga Salt Group in Vol. II Pal. of N. Y. The third column, the Wisconsin Guelph fauna, is from Vol. IV, Geology of Wisconsin.

The fauna of the Racine limestone is based upon Professor Hall's paper published in the Regents' Twentieth Annual Report on the Condition of the N. Y. State Museum.

The Chicago limestone fauna here given includes the species described in the twentieth report above mentioned, and also those described by Winchell and Marcy in their paper read before the Boston Society of Natural History in 1865 and such of those described by McChesney in 1861 as seemed to be distinct species.

The twenty-eighth report of the N. Y. State Museum of Natural History was taken as representing the fauna of the Waldron Ill. shale, and the remaining columns are mainly as given in Vol. II. of the Paleontology of New York.

The numbers given do not include all the fossils which have been described from the different localities, but it is believed that neither the discoveries which have been made since the works upon which they are based were published, nor those which may be made in the future will materially change the characteristics of the various faunas.

	Rochester Guelph.	Canadian Guelph.	Wisconsin Guelph.	Racine Limestone.	Chicago Limestone.	Waldron Ill Shale.	N.Y. Niagara Shale.	N.Y. Niagara Limestone.
Cœlenterata and Bryozoa,	8	6	16	?	16	37	38	28
Crinoidea, - - -	0	0	3	32	12	17	25	4
Brachiopoda, - -	9	13	19	7	15	31	37	4
Lamellibranchiata, - -	5	7	2	10	17	7	8	1
Gasteropoda, - -	21	42	21	18	17	5	3	1
Cephalopoda, - - -	11	17	10	16	15	2	9	3
Trilobita, - - -	1	2	1	10	9	14	11	2

A comparison of these columns shows that the new fauna agrees with that of the Canadian Guelph in the following particulars : the absence of Echinoderms, the rarity of the trilobites, and in the large proportion of Gasteropoda and Cephalopoda, really a closer agreement in general characteristics than that of the Wisconsin and Canadian Guelph faunas.

It is not now deemed best to dwell upon the differences between the new fauna and those represented in the remaining columns further than to remark that that difference is greater than is shown by the figures, the species of Gasteropoda from the new fauna are none of them identical with those of the New York Niagara shale or of the Niagara limestone, the same fact is true of the Cephalopoda and the other classes excepting three species which are also found in the Canadian Guelph fauna.

Beginning with the Niagara shale and tracing the development of this fauna through the Chicago and Racine groups to the Wisconsin Guelph, and finally to the Canadian Guelph, there appears to have been a gradual extinction of the Cœlenterata, Bryozoa, Echinodermata, Brachiopoda and Trilobita, and a marked development of the Cephalopoda and Gasteropoda, a fact which has an important bearing upon the relations of the Chicago and Racine beds to the other strata of the Niagara epoch and which the writer hopes to discuss in a subsequent paper.

Of the species found here twenty-three have already been shown to be identical with or very closely allied to Canadian Guelph species, among these may be mentioned the following :

Murchisonia macrospira,
" logani.
Pleurotomaria Durhamensis.
" Galtensis.

Cyclonema sulcatum.
Trochonema pauper, var.
Straparolus crenulatus.
Bucania augustata.
Certoceras myrice.
" brevicorne.
Orthoceras Selwini.
Phragmoceras parvum.
Trochoceras Desplainense.
Zaphrentis Racinensis.
Favosites occidens.
Etc., Etc.

The specimens are usually nicely preserved and form a valuable addition to our knowledge of the external characteristics of the Guelph fossils.

JANUARY 25, 1892.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD in the chair.

A large audience present.

The first lecture of the Popular Lecture Course for 1892 was given by DR. JULIUS POHLMAN of Buffalo, on

POPULAR MODERN SUPERSTITIONS.

The lecture was illustrated by numerous experiments.

FEBRUARY 8, 1892.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD, in the chair.

Fifty-one persons present.

The Curator of Botany, MISS BECKWITH, announced that a collection of botanical specimens from the Island of St. Helena, had been presented to the Academy by LIEUT. COMMANDER FRANKLIN HANFORD, U. S. N.

The COUNCIL report recommended :

(1.) The election of MR. CHAS. H. WILTSIE for resident membership.

(2.) The election of the following members, as fellows :

PROFESSOR ARTHUR L. BAKER,
MR. CHARLES W. SEELYE,
DR. M. A. VEEDER,
PROFESSOR CHARLES W. DODGE,
MR. WALTER B. SMITH,
MR. CHARLES H. WARD.

(3.) The election of the following corresponding members :

DR. JULIUS POHLMAN, Buffalo.
PROFESSOR W. H. LENNON, Brockport, N. Y.
DR. H. CARRINGTON BOLTON, New York.
DR. O. A. DERBY, Sao Paulo, Brazil.

(4.) The election of Mr. CHAS. D. WALCOTT, Washington, D. C., as honorary member.

(5.) The payment of certain bills.

Under a suspension of the rules the candidates recommended for resident membership, fellowship, honorary membership and corresponding membership were elected by formal ballot. The bills were ordered paid.

The PRESIDENT made a statement to the effect that, as the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE had accepted the invitation to hold its next annual meeting in Rochester, it was proper that all the institutions of the city should join in making preparations for the entertainment of the visiting association in a manner creditable to the city. It was eminently fitting that the Academy of Science should take the initiative in this matter, and the President suggested that, as the time had now come for some action to be taken, a special committee should be appointed by the Academy to secure concert of action among the many scientific, educational and civic bodies of the city.

Professor A. L. Arey moved that the President be constituted chairman of such a special committee with power to appoint six other members. The motion was carried.

The President appointed the following persons to serve on above committee:

Professor Albert L. Arey,
Mr. Joseph O'Connor,
Dr. E. M. Moore, Sr.,
Rev. C. B. Gardner,
Professor S. A. Lattimore,
Dr. J. Edward Line.

Dr. M. A. Veeder distributed among the audience a number of slips for keeping records of auroras, which he hoped many of those present would fill out. He also made a few remarks explanatory of the slips and upon auroras in general.

Dr. Veeder distributed the following printed report upon

The Auroras of January, 1892.

The following results appear to be justified by the reports of observations thus far received. As was anticipated and announced in advance to many of those receiving blanks for recording observations, the finest display of the month, and an aurora of the first magnitude, appeared on January 5th. Sporadic, and for the most part very faint displays, were reported on January 15th, 20th, 21st, 25th, 26th, 27th, 28th and 29th, those on the last three dates named being the best defined.

The reports from stations along the base line adopted, extending from Washington northward into Canada, show that the aurora of January 5th had a probable altitude of 175 miles and perhaps upwards. The amount of sky covered at different stations shows that the plane of the southern margin of the chief portion of the luminous mass reached the earth at a point on the 77th meridian not far from 45 degrees north latitude. Comparison with observations on other meridians shows that the aurora tended to reach its maximum brightness at the same hours of local time, rather than at the same hours of absolute time. A study of the arrangement of the arches and patches of light reported from different stations reveals the fact that they are very largely of the nature of halos, their position depending as much upon the position of the observer as upon the general source of illumination in the auroral mass. As in the case of a rainbow, each observer sees his own arch and consequently the elevation will be approximately the same at stations not too far apart to prevent the arch from being seen at all. In this way, also, the differences in the prismatic colors displayed, even at stations quite close together, may be accounted for. Hence the difficulty of employing arches or colors for the estimation of altitude. It is suspected that this may be true of streamers also.

The method of recording the absence as well as the presence of the aurora at each observation has made it apparent, especially in connection with the lesser displays of the month, that even well defined auroras may be confined within quite narrow limits, appearing, for example, at southern stations when absent at those directly northward. The aurora thus exhibits a tendency to frequent certain localities, presumably because of some peculiarity of the soil or topography of the country; but further observations in regard to this point are desirable.

Disturbed areas upon the sun, containing both spots and faculæ, appeared by rotation on January 4th, 6th, 15th, 21st, 28th, 29th and 30th. Thus the dates of auroral display during the month, and the extent of the displays reported, has been in exact conformity with the relations to solar and associated conditions described in the paper upon the Zodiacal Light, copies of which have been distributed generally to observers co-operating, and which may be obtained from the undersigned, from whom, also, blanks and circulars for auroral observations may be had. M. A. VEEDER.

February 8, 1892. Lyons, New York.

The following is a condensed form of the record slip distributed :

RECORDS OF OBSERVATIONS OF AURORAS.

Name and Postoffice Address of Observer,..

Latitude and Longitude of Station,________________________

INSTRUCTIONS.

Note the exact time at which an observation is made and *always* enter the result in the table, stating specifically whether an aurora was seen or not, or if clouds, moonlight, etc., intervene ; note that fact in the proper column. A blank space will be understood as signifying that no observation was made. If but a single observation can be had each evening, the best hour is probably from 9 to 10 o'clock P. M. When an aurora is seen give as complete a description as possible of its location and of any changes which it may undergo, employing for this purpose the blank space following the table. NOTE ESPECIALLY THE TIME AND ZENITH DISTANCE OF ALL PROMINENT FEATURES. Return to M. A. VEEDER, Lyons, New York, U. S. A.

AURORAS SEEN DURING THE MONTH OF..................189 .

	6 to 7 P. M.	7 to 8 P. M.	8 to 9 P. M.	9 to 10 P. M.	10 to 11 P. M.	11 to 12 P. M.	12 to 6 A. M.
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DESCRIPTIONS.

LYONS, NEW YORK, U. S. A.,..189

DEAR SIR :—If unable to make the records provided for in the accompanying blanks, you will confer a favor by handing them, together with this circular, to some one who may be able so to do. Even a single observation each evening properly recorded will be of service. More blanks may be obtained from the undersigned if desired.

In order to determine the local distribution and altitude of the aurora, it is desirable to have numerous observers suitably distributed throughout the area covered by the observations so as to secure as full information as possible as to the extent to which an aurora was present or absent during each hour. In case that an aurora is not reported from any given locality it is necessary to have the means of determining whether this failure was due to lack of observation, or to cloudiness, etc., or whether the aurora was really absent. For this reason it is desirable that there be as few blanks as possible in the table, although even the most fragmentary record may become of importance for purposes of comparison with others. The results already obtained warrant the belief that by concerted effort information of practical value may be secured. During the coming year auroras will probably increase in frequency, especially near the equinoxes and a single display having well defined characteristics, like that from Sept. 8th to 11th, 1891, may, if thoroughly observed, lead to most important conclusions.

Yours truly. M. A. VEEDER.

HON. MARTIN W. COOKE read the two papers on the program :

SUGGESTIONS IN RESPECT TO THE CAUSE OF THE MOVEMENT OF ICEBERGS TOWARDS THE EQUATOR.

THEORY OF THE CAUSE OF THE GULF STREAM.

The papers were illustrated by a chart of the world, a globe and numerous blackboard diagrams. The discussion on the papers was participated in by DR. VEEDER, MR. ARTHUR L. WHITE, PROFESSOR ARTHUR L. BAKER, the PRESIDENT and others.

On motion a vote of thanks was extended to LIEUT. COM. HANFORD for his generous gift to the Herbarium of the Academy.

FEBRUARY 29, 1892.

STATED MEETING.

The President, PROFESSOR H. L. FAIRCHILD in the chair.

A large audience present.

The PRESIDENT made a few remarks concerning the proposed topographical survey of New York State and suggested that it would be appropriate for the Academy of Science to take some action to further the accomplishment of the work by encouraging the State to authorize the survey.

MR. STREETER moved that a committee of three be appointed by the president to draft suitable resolutions and take such other action as they may deem necessary or expedient to aid the project. The motion was carried and the President appointed to serve on this committee the following members :

MR. EMIL KUICHLING,
MR. THEODORE BACON,
PROFESSOR ARTHUR L. BAKER.

ADMINISTRATIVE PROCEEDINGS.

OFFICERS, 1892.

PRESIDENT.

HERMAN LEROY FAIRCHILD, *University of Rochester.*

VICE-PRESIDENTS.

A. L. AREY, J. EDW. LINE.

SECRETARY.

P. MAX FOSHAY, 3 *Park Avenue.*

CORRESPONDING SECRETARY.

CHARLES WRIGHT DODGE, *University of Rochester.*

TREASURER.

J. EUGENE WHITNEY, 65 *State Street.*

LIBRARIAN.

MARY E. MACAULEY.

COUNCILLORS.

J. M. DAVISON, H. L. PRESTON,
J. L. ROSEBOOM, FLORENCE BECKWITH,
WILLIAM STREETER, HENRY A. WARD.

CURATORS.

FLORENCE BECKWITH, in Botany.
CHARLES WRIGHT DODGE, in Biology.
JOHN WALTON, in Conchology.