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GEORGE E. STONE, Ph. D.

ANNUAL REPORTS

OF THE

WORCESTER NATURAL HISTORY SOCIETY.

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FLORA OF LAKE QUINSIGAMOND.

Lake Quinsigamond, which is situated near Worcester, is one of the largest lakes in Massachusetts, and is about six miles long, hardly exceeding one-half mile in width, although in many places it is from fifty to one hundred feet or more in depth. It runs in a northerly and southerly direction along the edge of one of the geological dividing lines of the State which separates the central highlands from the less elevated areas of our seaboard. The immediate surroundings of the lake consist geologically of sand and gravel and probably the greater portion of the basin itself is made up of this material, over which there is spread a considerable mass of decomposed matter the results of centuries of vegetable and animal decay.

While a considerable portion of the basin of the lake is too deep to give rise to much vegetable life there are vast areas of shallow water which are especially adapted to a profusion of vegetable forms, thus making it one of the best collecting grounds in Massachusetts. Our observations on the flora of Lake Quinsigamond have covered a period of some years. During the summer of 1890 and under the auspices of the Worcester Natural History Society we gave the lake a constant and careful study for about six months, and the list presented here is largely the results of this study. The list is, we believe, nearly complete so far as the Spermaphytes, Pteridophytes, Bryophytes, and Characeae are concerned, and with the exception of the Desmids of which only 150 species and varieties are given, and the Diatoms, which are not listed at all, the Algae are tolerably well represented.

The Bacteria and Saprolegnieae have not been listed, and only those Desmids are recorded which were casually observed in connection with other plant material under observation. A thorough study of the Desmids and Diatoms of Lake Quinsigamond would undoubtedly reveal many new species, or at least many new forms, which have not heretofore been observed in North America, as is evident from the researches of Dr. G. Lagerheim made in connection with species of Utricularia at Tewkesbury by B. D. Green and preserved in Swedish herbaria, from which he described several new species and varieties of Desmids found attached to these plants. The list contains 450 species and varieties, and with the exception of those marked with an asterisk they were all found in Lake Quinsigamond. By adding these, all of the aquatic plants in the county so far as known are represented. The arrangement of species follows that of Gray's Manual, 6th edition, for the higher plants; that of Allen for the Characeae; Lesquereau and James for the mosses, and Wolle for the Algae.

Some of the species recorded here appear to be common to Lake Quinsigamond alone, although the greater majority of them have been observed by us in many other ponds in Massachusetts. So far, however, as I am aware no list of fresh water Algae possessing any degree of completeness has been published in Massachusetts, and for this reason a list of these it is hoped will be of some interest as well as value to botanists. In short, amateur botanists as a rule neglect all forms of water plants, as can be seen by consulting our local floras. It would appear that the Algae have received more attention of late years by the bacteriologists connected with our State Board of Health,

inasmuch as the presence of these organisms is now believed to possess some economic importance.

The Flora of Middlesex county appears to be the only one that has included any of the fresh water Algae peculiar to our Massachusetts lakes and streams.

In this work issued by Dame and Collins there is given a total of 204 species and varieties, some fifty of which are either salt water species or common to salt water marshes, thus bringing the purely fresh water species down to about 150. With the exception of the Desmids in this list, of which there are about eighty species representing those determined by Dr. Lagerheim, all of the fresh water Algae were taken from Dr. Farlow's herbarium. In the absence of extensive studies of our fresh water Algae throughout Massachusetts it is not possible therefore to make comparisons of the algal flora of the different regions. That characteristic differences exist in the flora of our ponds and streams is evident to those who have paid some attention to collecting. We have similar environmental factors to deal with in considering an aquatic flora as we have in a land flora. The nature of the soil which constitutes the lake or pond bottom is variable, both in its mechanical and chemical composition, and the chemical composition of the water is by no means the same for different localities. Chemical analysis has shown that the amount of chlorine in Berkshire county is .06 or .08 in parts per 100,000, while that in the vicinity of Boston ranges from about .35 to .65, and on Cape Cod it reaches as high as 2.62. The differences in the amount of chlorine undoubtedly influence to a considerable extent the character of a flora. Then, again, the clearness of the water, temperature, presence of currents, amount of sewage, etc., are factors which exert an influence upon the distribution of aquatic plants. Of the plants which require especial notice may be mentioned the following: Elodea Canadensis, which fruits abundantly every two or three years in Lake Quinsigamond, is confined entirely in central Massachusetts to this body of water and its adjacent streams. Hypnum aduncum, hamatum, Chara hydropitys, Reich, C. crinita Wallr, C. sejuncta, A. Br., as well as many of the Algae have not been observed elsewhere in this region. Among the rare Algae may be mentioned Craterospermum laetevirens, A. Br., which we have observed only in Lake Quinsigamond, and here in certain localities it is found abundantly in all stages of development.

Wolle remarks "That the only specimens recognized as possibly belonging to this genus were collected July, 1880, in Green pond, N. J. The conjugation was complete, but the spores were imperfectly developed, hence my hesitancy in calling it a pronounced species of this genus." Abundance of the mature fruiting forms have been observed in Lake Quinsigamond.

Pleurocarpus mirabilis, A. Br., an alga common everywhere, although most always sterile, was obtained from a small brackish pool abundantly in fruit in the summer of 1893. Wolle remarked that he observed this form for eight years without ever finding it in fruit, and in 1883 he reports it as having been found fruiting in four different places by as many observers.

It would be of some interest to ascertain whether such species are subject to a definite periodicity in their fructification, or whether they are dependent entirely upon ecological factors. It is quite evident from our own cultures of Algae that variations in the environment have a considerable bearing upon their fructification. Our observations during 1890 extended throughout the whole season, and we were therefore able to pay some attention to the seasonal distribution of forms.

There are two such marked periods which may be termed the maximum periods; one occurring in the spring, and the other in the autumn.

One of the most important factors which determine the occurrence of species is the height of the water. An increase of one or two feet in the height of water during the spring and summer months over that of a normal season will completely shut out for that season many forms of aquatic plants. During seasons

of abnormally high water we have looked in vain for certain species of Nitella and Algae, although they were abundant both before and after such seasons. The high water changes the light conditions which are so essential to certain species that they are incapable of developing.

Most of the species of filamentaceous Algae in this list have been preserved upon microscopic slides. The most satisfactory preserving fluid for this purpose we have found to be one made up as follows: glycerine, 1 part; water, 2 parts; alcohol, 3 parts.

The specimens to be mounted are placed in small amounts of this solution contained in a watch-glass where they are left until the water and alcohol has evaporated. After this has taken place they are laid on a slide and ringed and sealed. When this process is carried through rapidly, that is in three or four hours, and the specimens are kept in the dark, they will hold most of their color and form tolerably well for many years.

G. E. STONE.

Mass. Agricultural College, July 1, 1899.

SPERMAPHYTES.

Ranunculus.
Aquatilis, var. trichophyllus, Gray; multifidus, Pursh.
Brasenia peltata, Pursh.
Nymphea.
Odorata, Ait; odorata, var. minor, Sims.
Nuphar.
Advena, Ait; *Kalmianum, Ait.
Nasturtium officinale, R. Br.
Elatine Americana, Arn.
Myriophyllum.
Spicatum, L; verticillatum, L; ambiguum, Nutt; tenellum, Bigelow.
Proserpinaca palustris, L.
Callitriche.
Verna, L; *heterophylla, Pursh.
Décodon verticillatus, Ell.
Ludwigia palustris, Ell.
Sium Carsonii, Durand.
Bidens Beckii, Torr.
Lobelia Dortmanna, L.
Limnanthemum lacunosum, Grisebach.
Utricularia.
Inflata, Walt; *clandestina, Nutt; vulgaris, L; minor, L; gibba, L; intermedia, Hayne; purpurea, Walt; *resupinata, B. D. Greene; cornuta, Michx.
Polygonum amphibium, L.
Ceratophyllum.
Demersum, L; demersum, var. echinatum, Gray.
Elodea Canadensis, Michx.
*Vallisneria spiralis, L.
Pontederia cordata, L.
Juncus militaris, Bigel.
Typha latifolia, L.
Sparganium.
Eurycarpum, Engelm: simplex, Hnds; simplex, var. angustifolium, Engelm; simplex, var. androcladium, Engelm; minimum, Fries.
Peltandra undulata, Raf.
Spirodela polyrrhiza, Schleid.
Lemna.
*Minor, L; *trisulca, L.
Alisma Plantago, L.
Sagittaria.
Variabilis, Engelm; variabilis, var. angustifolia; variabilis, var. obtusa; variabilis, var. gracilis; graminea, Michx.
*Scheuchzeria palustris, L.
Potamogeton.
Natans, L; natans, var. prolixus, Koch; Oakesianus, Robbins; Pennsylvanicus, Cham; Vaseyi, Robbins; Spirillus, Tuckerm; hybridus, Michx; fluitans, Roth; pulcher, Tuckerm; amplifolius, Tuckerm; heterophyllus, Schreb; heterophyllus, var. myriophyllus, Robbins; perfoliatus, L; obtusifolius, Mer. & Koch; pauciflorus, Pursh; pusillus, L; pusillus, var. tenuissimus, Koch; pusillus, var. polyphyllus, Morong; gemmiparus, Robbins; Tuckermani, Robbins; Robbinsii, Oakes.
Naias.
Flexilis, Ros. & Schm.; indica, var. gracillima, A. Br.
Eriocaulon septangulare, Withering.
Eleocharis.
Robbinsii, Oakes; palustris, R. Br.
Scirpus.
Subterminalis, Torr; pungens, Vahl; Torreyi, Olney; lacustris, L; sylvaticus, L.
Spartina cynosuroides, Willd.
*Zizania aquatica, L.

PTERIDOPHYTES.

Equisetum limosum, L.
Isoetes.
Lacustris, L.
Echinospora, var. Braunii, Engelm; riparia, Engelm.

BRYOPHYTES.

Sphagnum.
Cuspidatum, Ehrh; cymbifolium, Ehrh.

Fontinalis.
Antipyretica, var. gigantea, Sulliv; Dalecarlica, Br. & Sch; Novae-Angliae, Sulliv; Lescurii, var. gracilescens, Sulliv.
Dichelyma capillaceum, Br. & Sch.
Hypnum.
Acutum, Mitt.
Aduncum, var. hamatum; riparium, L.
Porella pinata, L. Rivulets.
Plagiochila.
Porelloides, L. Rivulets; asplenoides, Rumort. Rivulets.
Riccia.
Fluitans, L. Rare; natans, L. Rare.

THALLOPHYTES.

LICHENES.

Endocarpon miniatum, var. aquaticum.

CHARACEAE.

Nitella.
Flexilis, Ag; glomerulifera, A. Br; mucronata, A. Br.; tenuissima, Deso: megacarpa, Allen.
Chara.
Coronata, var. Schweinitzii, A. Br; hydropitys, Reich. Rare; crinita, Wallr. Rare; fragilis. Deso; fragilis, forma tenuifolia, Dew; sejuncta, A. Br.

ALGAE.

FLORIDEAE.

Batrachospermum.
Moniliforme, var. pulcherrimum, Bory; vagum, var. keratophytum, Bory.

CONFERVOIDEAE.

Coleochaete.
Soluta, Pringsh; scutata, Breb; orbicularis, Pringsh.
Oedogonium.
Cryptoporum, var. vulgare, Wittr; fragile, Wittr; obsoletum, Wittr; plusiosporum, Wittr; concatenatum, (Hass.), Wittr; echinospermum, A. Br; capilliforme, Kg; Boscii, (Le. Cl.), Wittr; moniliforme, Wittr; hexagonum, Kg; longatum, Kg.
Bulbochaete.
Intermedia, D. By; crenulata, Pringsh; gigantea, Pringsh; mirabilis, Wittr.
Cylindrocapsa Amoena, Wolle.
Draparnaldia.
Glomerata, Ag; plumosa, Ag.
Stigeoclonium.
Tenue, Kg; tenue, var. irregulare, Rab; nanum, (Dillw.), Kg; protensum (Dillw.), Kg; amoenum, Kg.; radians, Kg.
Chaetophora.
Pisiformis, (Roth.), Ag; elegans, Ag; endiviaefolia, Ag; tuberculosa, (Roth.), Ag; longipila, Kg.
Microthamnion Kuetzingianum, Naeg.
Aphanochaete globosa, (Nord), Wolle.
Chroolepus aureus, (Linn.), Kg.
Cladophora.
Fracta, Kg; crispata, Kg; glomerata, Kg; Aegagropila, (Linn.), Kg.
Ulothrix.
Zonata. (W. & M.), Aresch; aequalis, Kg; tenuis, Kg; rivularis, Kg; flaccida, Kg; nitens, Menegh; varia, Kg; parietina, (Vauch), Kg.
Conferva.
Amoena, Kg; floccosa, Ag; affinis, Kg; vulgaris, Rab; punctalis, Dillw.
Rhizoclonium stagnale, Wolle.

SIPHONEAE.

Vaucheria.
Aversa, Hass; sessilis, (Vauch.), D. C.; geminata (Vauch.), D. C.
Terrestris, Lyngb.
Botrydium granulatum, L.

PROTOCOCCOIDEAE.

Volvox globator, Linn.
Pandorina morum, Bory.
Euglena viridis, Ehrb.
Gonium pectorale, Mueller.
Chlamydococcus pluvialis, A. Br.
Pediastrum.
Simplex, Meyen; forcipatum, (Corda.), A. Br; boryanum, (Turpin.), Menegh; pertusum, Kg; Ehrenbergii, (Corda.), A. Br; Ehrenbergii, var. cuspidatum, A. Br; tetras, Ehrb.
Coelastrum microporum, Naeg.
Sorastrum spinulosum, Kg.
Scenedesmus.
Caudatus, Corda; dimorphus, Kg; acutus, Meyen.
Ophiocytium.
Cochleare, A. Br; capitatum, Wolle.
Characium.
Pringsheimii, A. Br; ambiguum, Herm; Naegelii, A. Br.
Protococcus.
Viridis, Ag; viridis, var. gigas, Kg; viridis, var. Wimmeri.
Polyedrium.
Trigonum, Naeg; trigonum, var. tetragonum, Rab; gigas, Wittr.
Dictyosphaerium reniforme, Bulnh.
Hydrurus.
Foetidus, var. penicillatus, Ag.
Foetidus, var. irregularis, Kg.
Tetraspora.
Cylindrica, Ag; lubrica, (Roth), Ag; lubrica, var. lacunosa, Chaud.

Schizochlamys.
Gelatinosa, A. Br; decorticans.
Palmella.
Mucosa, Kg; hyalina, Breb; uvaeformis, Kg.
Porphyridium cruentum, Naeg.
Gloeocystis.
Ampla, Kg; vesiculosa, Naeg; rufescens, A. Br; rupestris, Rab.
Nephrocytium.
Agardhianum, Naeg; Naegelii, A. Br.
Raphidium.
Polymorphum, Fres; polymorphum, var. falcatum (Corda), Rab; Braunii, Naeg; convolutum, (Corda), Rab.
Dimorphococcus cordatus, Wolle.
Eremosphaera viridis, D. By.

ZYGOSPOREAE.

Spirogyra.
Tenuissima, (Hass.), Kg; inflata, (Vauch.), Rab; quadrata, (Hass.), Petit; Weberi, Kg; Grevilleana, (Hass.), Kg; calospora, Cleve; Hassallii, (Jenn.), Petit; quinina, (Ag.), Kg; communis, (Hass.), Kg; Jurgensii, Kg; longata, (Vauch.), Kg; nitida, (Dill.), Link; bellis, (Hass.), Cleve; orthospira, (Naeg.), Kg; crassa, Kg; jugalis, (Dill.), Kg; dubia, Kg; adnata, Kg; rivularis, Rab; majuscula, Kg.
Zygnema.
Leiospermum, D. By; insigne, Kg; stellium, Ag; anomalum, (Hass.), Kg.
Mesocarpus.
Scalaris, (Hass.), D. By; robustus, D. By; nummuloides, Hass.
Pleurocarpus mirabilis, A. Br.
Staurospermum, capucinum, Kg.
Craterospermum, laetevirens, A. Br.

DESMIDIEAE.

Hyalotheca.
Disiliens, (Smith), Breb; mucosa, (Mert.), Rolfs.
Bambusina Brebissonii, Kg.
Desmidium.
Baileyi, Wolle; quadratum, Nord; cylindricum, Grev; aptogonium, Breb.
Sphaerozosma.
Pulchrum, Bailey; pulchellum, (Arch.), Rab; filiforme, Rab.
Mesotaenium.
Braunii, D. By; micrococcum, Kg; Endlicherianum, Naeg.
Penium.
Digitus, (Ehrb.), Breb; margaritaceum, Breb; interruptum, Breb.
Closterium.
Juncidum, Ralfs; Lunula, var. striatum, Wolle; acerosum, (Schrank), Ehrb; striolatum, Ehrb; costatum, Corda; Dianae, Ehrb; Jenneri, Ralfs; parvulum, Naeg; Ehrenbergii, Menegh.
Docidium.
Crenulatum, (Ehrb.), Rab; Baculum, (Breb.), D. By; coronatum, Rab; nodosum, Bail; minutum, Ralfs.
Calocylindrus connatus, (Breb.), Kirch.
Cosmarium.
Constrictum, Delp; De Baryi, Archer; granatum, Breb; globosum, Bulnh; bioculatum, Breb; nitidulum, DeNot; crenatum, Ralfs; pyramidatum, Breb; pachydermum, Lund; dentatum, Wolle; amoenum, var. tumidum, Wolle; Phaseolus, Breb; Schliephackeanum, Grun; subcrenatum, Hantzsch; Broomei, Thwaites; commisurale, Breb; speciosum, Lund; ovale, Ralfs.
Tetmemorus.
Brebissonii, (Mengh.), Ralfs; granulatus, Ralfs; laevis, (Kg.), Ralfs.
Xanthidium rectocornutum, Wolle.
Arthrodesmus.
Convergens (Ehrb.), Ralfs; ovalis, Wolle; orbicularis, Wolle; Incus, (Ehrb.), Hass; octocornis, Ehrb.
Euastrum.
Crassum, (Breb.), Kg; ornatum, Wood; oblongum, (Grev.), Ralfs; verrucosum, (Ehrb.), Ralfs; ampullaceum, Ralfs; didelta, (Turp.), Ralfs; circulare, (Hass.), Ralfs; gemmatum, Breb; insigne, Hass; Pokornyanum, Grun; inerme, Lund; Nordstedtianum, Wolle; elegans, Kg; spinosum, Ralfs; simplex, Wolle.
Micrasterias.
Torreyi, (Bailey), Ralfs; Pseudotorreyi, Wolle; radiosa, (Ag.), Ralfs; papillifera, Breb; rotata, (Grev.), Ralfs; fimbriata, Ralfs; furcata, (Ag.), Ralfs; pseudofurcata, Wolle; dichotoma, Wolle; Crux-Melitensis, Ehrb; Americana, (Ehrb.), Kg; Mahabuleshwarensis, Hobson; truncata, (Corda.), Ralfs; conferta, var. hamata, Wolle; laticeps, Nord; oscitans, Ralfs; pinnatifida, (Kg.), Ralfs; Kitchelii, Wolle; arcuata, Bailey, expansa, Bailey; Baileyi, Ralfs; foliacea, Bailey; muricata, Bailey; Rabenhorstii, Kirch.
Staurastrum.
Multicum, Breb; multicum, var. minor; multicum, var. ellipticum; orbiculare, (Ehrb.), Ralfs; grande, Bulnh; majusculum, Wolle; dejectum, var. convergens, Wolle; brevispina, Breb; Dickiei, Ralfs; aristiferum, Ralfs; cuspidatum, Breb; trihedrale, Wolle; trifidum, Nord; avicula, Breb; commutatum, Kg; Bieneanum, Rab; margaritaceum.

Ehrb; striolatum, Naeg; polymorphum, Breb; crenulatum, Naeg., (Delp.); muricatum, Breb; asperum, Breb; punctulatum, Breb; pygmaeum, Breb; alternans, Breb; dilatatum, Ehrb; cyrtocerum, Breb; cyrtocerum, var. major, Wolle; cyrtocerum, var. pentacladum, Wolle; paradoxum, Meyen; arachne, Ralfs; comptum, Wolle; elongatum, Barker; pusillum, Wolle; cerastes, Lund; gracile, Ralfs; Ophiura, Lund; macrocerum, Wolle; odontatum, Wolle; pentacladum, Wolle; leptocladum, Nord; Ankyroides, var. hexacerum, Wolle; nanum, Wolle; vestitum, Ralfs; Sebaldi, Reinsch; Pseudosebaldi, Wille; anatinum, Cooke and Wills; teliferum, Ralfs; echinatum, Breb; tridentiferum, Wolle; furcigerum, Breb; eustephanum, (Ehrb.), Ralfs; enorme, Ralfs.

SCHIZOSPOREAE.

Calothrix Hosfordii, Wolle.
Isactis caespitosa, (Kg.), Wolle.
Gloeotrichia natans, Thur.
Rivularia dura, Kg.
Scytonema.
Tolypotrichoides, Kg; cortex, forma saxicola, Green.
Tolypothrix.
Distorta, Kg; muscicola, Kg; pulchra, Kg.
Sirosiphon ocellatus, Kg.
Hapalosiphon.
Braunii, Kg; Brebissonii, Kg; fuscescens, Kg; tenuissimus, Grun.
Nostoc.
Commune, Vauch; rupestre, Kg; pruniforme, Ag; verrucosum, Vauch.
Anabaena.
Variabilis, Kg.
Oscillarioides, Bory.
Cylindrospermum, limnicola, Kg.
Lyngbya papyrina, (Kg.), Kirch.
Oscillaria.
Subtilissima, Kg; tenerrima, Kg; antliaria, Juerg; gracillima, Kg; leptotricha, Kg; aerugineo-coerulea, Kg; tenuis, Ag; limosa, Ag; natans, Kg; anguina, Bory; Froelichii, Kg; princeps, Vauch.
Leptothrix.
Tenax, Wolle; rigidula, Ag; laminosa, Kg.
Coelosphaerium Kuetzingianum, Naeg.
Clathrocystis aeruginosa, Henfr.

SUMMARY.

Spermaphytes,			88
Pteridophytes,			4
Bryophytes,			15
Thallophytes	Lichenes,		1
	Characeae,		11
	Algae,		
		Florideae, 2	
		Confervoideae, 53	
		Siphoneae, 5	
		Protococcoideae, 52	
		Zygosporeae, 30	
		Desmidieae, 150	
		Schizosporeae, 39	
			331
	Total,		450

PRESIDENT'S ADDRESS.

Ladies and Gentlemen of the Worcester Natural History Society:

With the close of another year, it is proper that I should give to you a brief statement concerning the work of the Society, its present needs and its promise of future usefulness.

For a description of the class work, the collections, donations, and the general routine work of the Society, you are referred to the report of the Custodian, and a satisfactory statement of finances will be given in full in the report of the Treasurer, while the Superintendent of the Museum will state to you, far better than I can do, the condition of the Museum and some of its needs.

The past year, although not marked by any unusual effort, has been one of general success. The work has been carried on quietly, but with industrious fidelity, and the results have been, upon the whole, satisfactory. We can look forward to another year with the hope and belief that the interests of the Society will not suffer, and that we shall be able to effect better results in the future than have been possible in the past.

Our hope is that the Society may not only go on with its work, but that it may progress, and that the requirements for this may not long be withheld. Accomplishing all that the Society does in promoting the taste for a study at once refining and elevating in its tendencies and influences, it feels that its efforts should not be allowed to become fruitless through want of means to further its educational work without constant fear of financial embarrassment. Of the aspirations of the Society for the future, I am sure they are such as will commend themselves to all who recognize that progress is duty. We wish to meet the increasing call for instruction in the history of nature from this rapidly-growing community, and from all such as must depend mainly upon home instruction, that is, upon instruction received from without the regular channels of education.

With this purpose in view, we desire an enlarged and properly-equipped laboratory, and such other facilities as may be required. Our hopes and aspirations can not be realized without more extensive accommodations. We greatly need an enlarged museum building, with cabinets for our collections; a well-equipped laboratory for students who may be engaged in original research in any department of natural history; larger class-rooms for the accommodations of our pupils; and a hall for lectures. In fact, we need a building which shall best serve all the purposes and designs of our Society, which is by no means the case with our present accommodations.

We ask little or nothing for specimens illustrative of natural history. In a former communication I have stated to you my conviction that it is unwise for a society whose purpose is the study of natural history to undertake the formation of a museum of any pretension unless it is endowed with ample means for the constant care and preservation of its collection by thoroughly competent and well-paid curators and custodians. Besides, I believe that any considerable attempt to furnish a museum with extensive collections of specimens and elaborate arrangements for their care, would so distract the attention of the Society and divert its means and energies that little or no real study of natural history would ever again be attempted, and our museum become a meagre show-room, rather than a school devoted to the study of natural history.

While suggesting and pleading for these things, I am met with the inquiry, Of what use? With all our school advantages, why crowd the minds of the young with more? especially as we are told that our youth are crowded and overtaught. Why add to their labors by these studies, so nearly outside of their school duties? With all school work and its methods I have no controversy. I know, of course, that such instruction is and must be only preparatory to any scientific training. What we would do here is to supplement the work of the school by bringing the minds of the pupils into direct relation with facts; that they should not merely be told a thing which they must memorize, but made to see, by the use of their own intellectual powers, that the thing is so and can not be otherwise. This is the great advantage in the pursuit of any scientific study, and particularly in the pursuit of natural history, enabling the student to draw conclusions from particular facts made known to him by immediate observation of nature. This is a discipline which prepares the young for the duties and pleasures of common life: what we have to meet, and what we have to do in our every-day life. In this work-a-day world nearly everything which demands our attention is matter of fact, and needs, in the first place, to be accurately observed or apprehended, and then to be interpreted by processes of reasoning. I mean that whatever the youth takes for granted he takes at his risk.

In the study of mathematics the teacher starts with a few propositions, the proof of which is obvious. Nearly all that follows consists of deductions from these propositions. The teaching of language is of a very similar nature. In history the facts are still taken at second-hand. You can not make the pupil see the Battle of Bunker Hill or the Landing of the Pilgrims. There is no getting in actual contact with fact. The pupil must rest entirely on the authority of the teacher. There is no dispensing with it.

Not so in the teaching of natural history. An effort is always made to make the instruction eminently practical. In explaining the phenomena of nature the teacher as far as possible, gives reality to his instruction by object lessons. In teaching botany the pupil sees the plant in its native habitat, in all its stages of growth and development; he handles it, dissects and analyzes it, and thus learns by actual contact its whole natural history. In teaching mineralogy the pupil must, as far as possible, see the mineral in its native bed, and when it comes to the class-room he must handle it, weigh it, try to fuse it, observe its color and arrangement of particles, and its density and hardness, and so become thoroughly familiarized with it.

If we pursue this subject carefully and conscientiously, you may be sure that, however scanty our means, we shall have established an intellectual habit of great value in the affairs of daily life.

We observe here that the young are constantly seeking information about the world around them. They want an object lesson in natural history. The means are always at hand in lavish profusion. The need is only to find competent instructors who are willing to give this amount of help, instructors who really and practically know and understand what they attempt to teach. Such instructors I know (we have had them here), who clothe their subjects in easy language, and with the completeness of conviction, with which they talk of any ordinary every-day matter, who are so perfectly at home in the subject-matter of their theme that they fascinate their hearers with a lively confidence, born of personal conviction, which cheers and encourages the inquiring and waiting pupil.

Until within a comparatively recent time education has been devoted mainly to the cultivation of the power of expression and to the sense of literary beauty. If, instead of this, natural science were made the foundation of education rather than a pretence of embellishment, a much better state of things would exist.

In speaking as I do of the necessity and value of natural science, I do not lose sight of the work now of late being done in the common schools, in what is

termed nature-study. A great step in the right direction has been taken by this movement, giving to pupils who can not remain in school beyond the eighth and ninth grades a taste for natural science and a love of nature, which will in after years be of inestimable value in the broadening influence which it gives, not only to their powers of observation, but to their ability to know and to understand the best of that which the world contains in literature, in art and in science, by enabling them to better understand the magnificent beauty, usefulness and worth of the world about them. It will serve to make their lives more full and complete, and whatever may be their lot in after life, they will be wiser, happier and more useful in their day and generation by their communion with nature.

Communion with nature is one of the great essentials for the increase of human knowledge. It is one which must be gained by slow and difficult steps. Anything that helps us to secure it, anything that brings nature closer to the young, and the young closer to nature, is doing a good far beyond the limit of youthful days. Just think for a moment of the homes from which some of the pupils of our public schools come; of the absolute ignorance of all the beauties of nature, and of the beneficent mysteries extending over all; of the luxuries she holds in her bountiful lap, which are not even recognized by the youthful recipients. Think of the darkness which hangs over house after house and tenement after tenement in this our goodly city, and think how grateful we should be that from this society, and from our schools, the light is breaking and reaching into these places; that there is now no home so far away but that the love of and the kindly influence of nature will reach and take possession of it.

That is the service we are here to perform, and happy should I be could it be said we performed our whole duty. True our classes receive instruction from the best teachers. Our scanty collections are used in illustration. Our doors are open and free to all. The light goes out from them, and its feeble rays help gladden the earth.

I think I once said to you that the human race has more and greater benefits to expect from the study of natural history than from all other sciences put together. I do not forget the wonders of electrical science, the transmission of thought, will and fact; nor do I leave out of mind the power of steam in making it so easy to transport large armies with their armament and supplies with despatch, and to distribute to all countries the productions of each. These great achievements of mechanics and physics produce important effects on the well being of man. But it is doubtful if we are any healthier, happier or better for these wonderful achievements of man's ingenuity.

Most certainly our true welfare lies in the progress we make in the study of natural history, and the application of the knowledge thus gained for the overcoming of the evils which afflict our race. The very evils which afflicted the ancient Egyptians are resistless to-day, and many others which the subjects of Pharaoh were wholly ignorant of, trouble the husbandman with each returning year. The forester and horticulturist are at times almost ready to abandon their vocations, and give up their trees and fruits to the ravages of some prolific worm or insect. The farmer finds a pest for his crops, while pleuropneumonia depletes his herd. Then there are the regular diseases to which we are so accustomed that we are apt to consider them normal phenomena, and new diseases which appear or reappear at intervals, together with an occasional pestilence like the bubonic plague, which leaves death and desolation in its trail. We are so ignorant of the means of eradicating or resisting these afflictions that we cowardly come to regard disease as a part of the order of nature over which we can win no control.

But, when we consider what has been accomplished, shall we not declare that this idea of nature, and of man's relation to his environment, is weak, stupid and

ungrateful? Can we not see that by the patient, thorough, cumulative study of natural history in all its branches, we shall by slow degrees arrive at a knowledge of plants and animals, and of the favorable and unfavorable conditions of life for all living things, which will give us control over many evils that we now find wholly mysterious and irresistible?

Consider what great strides have been made in medicine and surgery, and in the knowledge of the human frame. Any physician will tell you to-day that the means and methods of observation, diagnosis and treatment have wonderfully improved in a generation; and that many operations are successfully performed which were formerly thought to be impossible; and the whole plan of preventive medicine and public hygiene has been developed in a comparatively brief period; and the scientific study of heredity is now engaging the attention of scholars and philanthropists everywhere. The morbid anatomist is no longer satisfied with the gross external appearances, but looks for abnormal cellular changes which are the symptoms of disease. The physiologist studies the birth, growth and functions of living animals. The embryologist seeks to know those slight changes in the egg which have such a diversity of meaning in the progress of life. Earth and air have been explored, and we are daily informed of the weather of to-morrow. Even the ocean depths are forced to reveal their mysteries, and their fauna, their currents, their geological formation are now made known. The more we study nature and the more we become acquainted with her endless forms of life and growth and beauty, the more we shall realize that this earth was not made for man alone.

This idea that the earth was made that man alone might live will not long survive our acquaintance with the vast solitudes of earth and ocean and their inhabitants. Let us then accustom ourselves to look out and not in; to look up and not down, and we shall soon learn that we are but *one*, though a noble one, among countless races of beings which people or have peopled the earth, and that our welfare is not the sole end and aim of creation, or the one sole idea of our Creator.

I wish now to extend to Mr. Braman my sense of obligation for the generous interest he manifests in the welfare of the Society, and for the ready and intelligent assistance he has given on all occasions.

To Miss Dewhurst I am also under obligation for the careful, considerate and industrious devotion to her duties. Both Mr. Braman and Miss Dewhurst have performed all their duties with rare fidelity.

The house, grounds and property of the Society, under the care of Mr. and Mrs. Coburn, suffer no waste or depreciation from their faithful and economical care and attention.

MERRICK BEMIS,
President

TREASURER'S REPORT.

Report of Henry Billings, treasurer, for the fiscal year 1899-1900:

RECEIPTS.

Cash on hand as per last report.	$303.70
Rent of Lake Quinsigamond property	300.00
Income invested funds	383.75
Henry E. Hill, trustee Conant fund	367.50
Assessments	149.00
Sale of "Physical Geography of Worcester"	2.00
Interest on deposits	11.78
Total	$1,517.73

EXPENSES.

Metered water and meter repairs	$10.44
Custodian, care of rooms, furnaces and sidewalks	512.00
Insurance	36.75
Tax, 1899	93.41
Street betterment assessment	115.54
Postage, revenue stamps and stationery	3.64
Gas	6.24
Coal	136.75
Advertising	21.83
Sterling lectures	183.30
Expenses of classes and museum	115.76
Printing	32.70
Cash on hand to balance	249.37
Total	$1,517.73

REPORT OF THE SUPERINTENDENT OF MUSEUM.

Mr. President, Ladies and Gentlemen of the Society:

According to a pamphlet prepared for the Centennial exhibition in 1876, our society had 12,000 specimens in its several departments, "many of them of great variety and value." We certainly have more now than then, for additions have yearly been made—many more than enough to offset those lost naturally through decay.

Of these specimens the birds are deteriorating. This condition of affairs is helped along by the fact that we loan them freely to the teachers for use in the schools. Consequently many are in poor, others in bad, condition. These should be replaced by perfect ones. Twenty-five have been bought during the past spring that were desirable. Several birds of the county are lacking in our collection. There is an opportunity to improve this department greatly from a collection of Worcester County birds now for sale in this city, but the lack of money prevents our buying. The nest and egg department is far from complete, and should be bettered.

The insects are not in the best of condition, and should be gone through, with a view to remove the worthless specimens, rearrange, and fill the gaps as far as possible. Great effort should be made to illustrate the life history of as many as possible, especially those which are typical and those which are beneficial or injurious to man.

The specimens in other departments are in fair condition.

Such material as there is, we have not room or cases in which to display properly; indeed, some of it is still unpacked, remaining in the boxes in which it was put upon our removal from Foster street. It

is slowly being rearranged with a view to improve the Museum. Our botanical department is not displayed at all permanently. During their season we display the wild flowers, but each is short-lived. Our permanent collection consists of pressed specimens locked up in drawers and cases, seen only when needed for study. The collection is good as far as it goes, but not complete. The gaps should be filled, and those plants imperfectly, should be perfectly illustrated. This department of life might be permanently shown by means of pressed specimens, consisting of plants and their parts in various stages of growth, mounted behind glass, and hung in order, where they can be seen. A typical plant of each family, at least, of the county, ought to be thus shown, together with typical plants showing the orders not found in this county.

We ought to show the simple forms of life—animal and vegetable—by means of pictures and models; and microscope slides should be had to illustrate the same.

A visitor to our Museum ought to be able to start at the simplest forms of life and follow up to man on the one hand and the highest plants on the other, on the plan suggested by Agassiz, namely, the outside world represented by a type of each important group or order and Worcester County by every species.

Our library is very small, and few of its books are up to date; so we need many books and should also be able to subscribe for several of the periodicals devoted to natural history.

We need a lecture room. Repeatedly during the past year the room so used has been too small to hold all who came, and our chairs were too few to seat all who could get in. The chairs number about 60; some of them broken. We supplement them with about 20 camp stools, which are not very stable.

As much is being done with our present income as can be done. Some of the improvements suggested may be made by a small addition to our yearly income; but to do all this as we might, involves considerable money and a suitable building in which to display our material. Such a building would give opportunity to show well biological series from lowest to the highest plant and from lowest animal to man, arranged so as to have educational and utilitarian value. It would also show the minerals and rocks of the county and the important ones of the outside world; the geologic systems of the country, state and world; structural and phenomenal geology, economic geology; palaeontology in connection with biology and geology. It would have mineral, chemical and biological laboratories, lecture rooms, and a suitable library. The material in such a building could be so arranged as to make it as good a place of recreation even as an art museum.

What an immense influence for good such an institution might have in this city!

We are doing good work as it is. Our building is out of the way in location, off a street car line, and on the top of a somewhat forbidding hill—especially in the heat of summer, and with the ice of winter—notwithstanding we are visited by 6,000 people yearly. Many, old and young, come to see our exhibits, permanent and transient; many to attend the lectures and classes—and thus through those who are teachers, indirectly hundreds of children of the schools are reached. Many teachers bring their classes here for study; many come for specimens to study both here and at home, and teachers for material with which to illustrate lessons at school (as your custodian's report shows); many children come to attend the bird, botany and other classes; many people come for the purpose of identifying and having identified birds, insects, minerals, rocks; some to learn the best way to combat harmful animals and plants.

All this is unmatched in the wide world, and as free as the air we breathe. It seems to me that the people of Worcester should be proud of such work and enthusiastic in its support.

HERBERT D. BRAMAN,
Superintendent.

CUSTODIAN'S REPORT.

Mr. President, Directors and Members of the Society:

Another year has passed, and the work of the Worcester Natural History Society is still broadening. There has been evidence of this throughout the year, but more especially in the springtime. Teachers seem to be awakening to the fact that for the children to see what they study about in natural history, is a great help. During the past year several teachers have brought classes of children to the Museum. Pupils from the kindergarten, primary, intermediate, grammar, and even those from the High Schools have benefited much from the collection of this society. Teachers and pupils and other students have been helped in special lines of study and investigation, and in many cases shells, minerals, flowers, birds' nests and insects have been identified.

In the spring of 1899 the classes were continued through June, Mr. Parker's bird class meeting on Mondays; Miss Trumbull's botany class on Fridays; the children's bird class with Mrs. Freeman once a week; and the children's botany class, with Miss Dewhurst, Wednesdays and Saturdays. May 2d and 9th Miss Sarah Averill gave two very interesting and instructive lectures on "Cross Fertilization." May 25th Prof. Joseph Perry delivered a second lecture on the "Geology of Worcester." This completed the course of eight lectures given by four English High School teachers, the others being spoken of in detail in the last report.

August 19th the Museum was closed for two weeks. The wild flowers exhibited up to that time showed a total record of 336. September 5th the Museum was opened with an exhibition of fall flowers and fruits, numbering 75 varieties. This was continued until the middle of October, when a fine collection of pressed specimens of Worcester County trees and shrubs was displayed.

The fall classes began November 16th, when Dr. John M. Bemis met those interested in forming a class in Elementary Biology. November 20th Mr. Braman's class in Mineralogy held its first meeting. Both of these classes continued to meet once a week through the winter. They were well attended by interested students, who expressed their appreciation of the work done and regretted when the last meetings were held. Miss Edith Barnes of Northboro was given the use of the lecture-room for a private class in Mosses. The first meeting was Feb. 21st, and the class continued once a week for ten weeks.

During the month of January there was a display of the common minerals and rocks of the world. These were to illustrate Crosby's work. In February the fossils belonging to the carboniferous period were shown. In connection with these, Prof. Perry's recently-found specimen of Lepidodendron acuminatum occupied a conspicuous place, also photographs of that found by him sixteen years ago. In March the corals made a beautiful exhibition. These special displays attracted the attention and consideration of a good number.

The spring classes of 1900 began Monday, March 26th, when the adult bird class held its first meeting with Mr. Wendell P. Parker. The attendance of this class has shown that the interest in bird study is steadily increasing. There were ten lecture meetings and a few field outings. At the indoor meetings each week, new bird arrivals were reported, also nests and eggs. Mr. Parker's lectures were planned accordingly, the different bird families being fully discussed as soon as they were well represented by migrants and summer residents. Friday, March 30th, the adult botany class held its first meeting with Miss Arabella H. Tucker. The course of ten lectures given by Miss Tucker was thoroughly appreciated. They were entertaining and interesting, popular, yet very instructive. Bits of literature were woven in now and then. After each

meeting the class went away satisfied that something worth while had been learned about the different divisions of the plant world. May 9th the children's bird class met with Miss Dewhurst. There being about forty in the class, it was divided into two divisions for field meetings, each division going out once a week, and both divisions spending an hour at the Museum Saturday mornings. So far as practical, the different bird families have been discussed in class and observation by the children noted. Incidentally, botany has been combined with the outings. The class closed the last Wednesday in June with a field day at Tower Park.

Wednesday evening, June 20th, Dr. John M. Bemis gave an interesting and instructive lecture on "Some Psychological Points in the Study of the Brain." It was illustrated with blackboard drawings, which helped the audience to better understand this comprehensive subject.

The classes and lectures were planned by our president, to whom the public is greatly indebted.

With the first catkins and tree buds, the exhibition of spring flowers was started April 5th. Although the first of the season was somewhat backward, Mr. Braman had not failed to provide an abundance for the exhibition. Miss A. M. Moore, a member of the Society, has also contributed largely to the display. Some of the rarer wild flowers have been obtained from the Horticultural Society exhibits. Mr. Henry Kinney has also brought in a few of the rarer species. Up to the present time there have been exhibited 61 trees, shrubs and vines, and 145 herbaceous flowers, making a total of 206 species.

The attendance from April 1st, 1899, to April 1st, 1900, has been 6,322. During that time there have been loaned 226 birds, 11 mammals, 9 lots of minerals, and several fossils, shells, books and charts. There have been sold at the Museum 33 copies of Prof. Perry's Physical Geography of Worcester, also five sets of minerals and a few duplicate shells.

These contributions have been received: Specimens of rock from Dunbarton, N. H., Prof. William F. Abbot, of this society; oven bird, Robert Leslie, city; several lots of wild flowers, Miss A. M. Moore, of this society; Cecropia moth, Mrs. H. A. Bryant, city; Luna moth, Mrs. E. A. Putnam, city; wild flowers, Mrs. J. A. Balcom, city, Mrs. Isaac D. White, city, and Mrs. M. A. Maynard, Northboro; two Cecropia moths, a young man; Cecropia moth, Mr. Walter Claflin, city; Sphinx moth, a young man; beetle from Marietta, Wisconsin, Mr. Frank M. Keith, city; chimney swift, Dr. Merrick Bemis; chrysalis of the Archippus butterfly, Mrs. Henry Phelps, city; nine birds' nests, Arthur Reynolds, city; a collection of shells and minerals, formerly belonging to Helen C. Reed, given by Mrs. A. Eliza Whitcomb, city; mineral specimens, Mr. J. L. Emmons, city; young alligator, alive, Mrs. Chetwood Smith, city; berries and leaves of the pepper tree of California, Miss A. M. Moore; weasel, Miss Alice Chapin, city; two specimens of lignite, Miss Marianna H. Kent, city.

Books contributed to the library are; Smithsonian Institute Report for 1897; Systematic History—The Worcester Records, Mr. Franklin P. Rice of this Society; "The Book of Nature," by John Mason Good, and "Phytologia, or the Philosophy of Agriculture," by Erasmus Darwin, given by the American Antiquarian Society; Part I of "The Birds of Eastern North America," by Charles B. Cory, from the Field Columbian Museum, Chicago; North American fauna, No. 16, from the U. S. Department of Agriculture; "Our Planet, its Past and Future," by William Denton, given by Mr. Franklin P. Rice; City Hall Memorial, from the City Council; Transactions of the Wisconsin Academy of Sciences, Arts and Letters; Smithsonian Institute Report for 1892, from the American Antiquarian Society; and these pamphlets: "The Production of Precious Stones in 1898," by George F. Kunz, from Washington; 35 copies of the "Flora of Lake Quinsigamond," Prof. George E. Stone, author and donor.

These books have been added by purchase: "Guides for Science Teaching—No.

III.;" "Commercial and Other Sponges," No. IV., "A First Lesson in Natural History;" No. V., "Common Hydroids, Corals, and Echinoderms;" "Trees of Worcester," by Arabella H. Tucker; and Chapman's "Handbook of the Birds of Eastern North America."

The Worcester County collection of birds has been materially improved by the addition of twenty-five mounted specimens. The corals and sponges have been brought down from the upper hall and re-arranged in cases in the lower hall. Three hundred copies of the annual reports for 1898-99 have been printed and distributed among the members and others interested in the Society. By request of the American Naturalist, a paper descriptive of the Worcester Natural History Society, written by Mr. Braman, appeared in the September number. During the winter and spring four articles have been written by Mr. Braman for the Sunday Spy. These are on the geology, land shells, and trees of Worcester County, nature study in the public schools, March birds, and the aquatic plants of Lake Quinsigamond as shown by Prof. Stone's "Flora of Lake Quinsigamond."

Respectfully submitted,

BESSIE LONG DEWHURST,

Custodian.