BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXIX.

1897.

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 29. SALEM: JANUARY,—JUNE, 1897. NOS. 1-6.

ANNUAL MEETING, MAY 17, 1897.

THE annual meeting was held in Plummer Hall, this evening, at 8 o'clock, the President in the chair.

The reports of the Executive Committee, Treasurer, Auditor and Librarian, were read, accepted, and ordered to be placed on file.

The report of the Committee on Nominations was presented, and the following persons were nominated and unanimously elected:

PRESIDENT:

ROBERT S. RANTOUL.

VICE PRESIDENTS:

FRANCIS H. APPLETON,
ABNER C. GOODELL, JR.,
EDWARD S. MORSE,
ALDEN P. WHITE.

SECRETARY:

HENRY M. BROOKS.

TREASURER:

WILLIAM O. CHAPMAN.

REPORT OF THE EXECUTIVE COMMITTEE, MAY 17, 1897.

Owing to the illness and absence of the Secretary, Henry M. Brooks, the Executive Committee prepared a full report of the work of the Institute during the past year. This report was read by President Rantoul. It showed that the year just closed had been a prosperous one for the Institute, and while the work of the Society had been hampered by the continued illness of the Secretary, the Assistant Librarian and the 2d Assistant Librarian, yet the routine work had been carried on and the Institute was in good condition,—its publications had contained articles of great merit which must prove of value to the historical and scientific student. The regular lectures and the less formal meetings, where papers were read by members of the Institute, were noted and highly commended. The matter of field meetings was considered and a continuance advised. The pressing need of more room for the many hundreds of volumes received by donation during the past year was referred to and a strong appeal for the necessary funds to bring about this much desired result was made. Reference was made to the death of Mr. William J. Foster, who had of late been of great assistance at the rooms during the illness of the Secretary. The loss the Institute had sustained in the death

of Vice-President Hagar was noted, and the valuable and long-continued service of the deceased was referred to.

Vice-President White offered the following resolution which was unanimously adopted:

Resolved: That in the judgment of this meeting, the fiftieth anniversary of the founding of the Essex Institute ought not to pass without a distinct and emphatic recognition, and that the Council take steps to carry this vote into effect.

GEORGE M. WHIPPLE,

Secretary, pro tem.

The Executive Committee's Report was as follows:

The Essex Institute has been from the beginning dependent to a very large extent upon the spontaneous help of volunteers, and the class of persons to which such an institution can appeal being a busy and preoccupied class, it is impossible to depend upon the attendance of most of the committees except on special occasions. The institution is too large to be conducted longer by one man, even if that man were its founder. Accordingly, resort has been had, of late years, to an executive committee, which is now practically charged with administering the Society's affairs, and it seems fit that some report should be heard from it, in the enforced omission of the usual report from the Secretary.

To a very exceptional extent the Institute has been hampered this year by the absence, through sickness and other causes, of its working officers and members. New comers, be they ever so well disposed, cannot fill the places of experienced workers. But it has not been the practice of the Institute in the past to magnify its difficulties, and fortunately there is enough of encouragement in

the record of the year just closed to make repining needless. The loss by death of two presidents in quick succession had disordered to some extent, before this year, the normal state of our affairs, and it has been the cherished purpose of the Executive Committee for this year to restore to a regular system as speedily and as fully as might be, the running machinery of the Society. The recent death of William J. Foster removed one of the most esteemed and valued of our volunteer assistants.

The Historical Collections are now printed and distributed for the year 1896. The Bulletin is also complete for the year 1895. Both of these volumes lie before you on the table, and will be found to be made up of matter of a quality as valuable as and possibly more readable than those of some preceding years. Large use has been made in both volumes of illustrations, which modern electrical methods produce at a cost within our reach. Our pages have been opened freely to the papers offered by the Local History Class.

The Lecture courses have been well sustained and well attended. Nine free lectures have been furnished, of a quality which, it will appear on a recital of the list, it would be difficult to better. Professor Goodale of Harvard opened the course with an illustrated lecture on the Botany of New Zealand. Subway-Commissioner Gargan followed with an illustrated account of the great Boston enterprise. Next came Prof. Arlo Bates of the Institute of Technology on "The Language of Literature," followed by Professor Minot of the Harvard Medical School on the great Russian Naturalist, von Baer. The fifth lecture was from General Curtis Guild, Jr., on the "Sword in Warfare." The sixth was by Rev. E. D. Towle on the Poet Holmes, and the next by Professor Ripley of the Technological School on "Some Peculiar People of South-

ern France." Louis Prang followed him, on "Chromo-Lithographic Art," and Dr. Hasket Derby, describing "Wisbuy, a Dead City of the Baltic," completed the series. The last three lectures were copiously illustrated. The promise of another lecture on the "Old Time Clergymen of Salem," by Rev. J. W. Buckham, was defeated by the illness of the speaker.

The nature of these addresses is at once a tribute to the character of the audiences which our courses command and an evidence that the work of the Institute is held in high esteem amongst the class of lecturers who are able and willing to make gratuitous contributions to popular culture. Our own home course of evenings in the Institute Building has been also well sustained and furnished several papers which have been accepted for the Historical Collections. Wm. L. Welch, Gilbert L. Streeter, John Robinson, Arthur H. Chase, Edward A. Silsbee, Ezra D. Hines, Mrs. Henry Wardwell, Mrs. W. S. Nevins and Miss A. L. Warner have each, in turn, occupied evenings, —Mr. Streeter two,—in an acceptable manner, and a considerable number of local topics have been illustrated and discussed.

The Institute has commemorated the seventy-fifth anniversary of the founding of the Essex Historical Society, which was practically its own birthday, for the mantle of the Historical Society has fallen, for better or for worse, upon the shoulders of the Essex Institute. Before the next ensuing annual meeting, the Institute will be called on, in March, 1898, to give an account of its stewardship for the first half-century of its corporate life. It would be well if this present annual meeting should indicate, in some way, what notice it would wish the Society to take of this event.

Prof. Daniel B. Hagar, a vice-president of the Institute for many years, has since the last yearly meeting removed

from the county and soon after died. His many services, fitly commemorated in our records, at the time, have not been forgotten.

The Institute has felt called on, during the year, in common with other like bodies, to declare its views on several public questions closely allied with its work. In these cases, your Executive Committee has ventured to submit resolves at regular meetings of the Institute, and these have, without exception, met the approval of the members present. In this way the voice of the Society has been raised against the destruction of the Frigate Constitution; in favor of acquiring for a State Park the Stage Fort property on Gloucester Harbor; and in favor of a proposal, submitted by the Swiss Government to the Universal Postal Congress just holden at Washington, for admitting to the mails of the world scientific specimens at the same postal rates as samples of merchandise.

The Institute in the early period of its career derived great advantage from a system of field-meetings adopted, as Dr. Wheatland said at a field-meeting at Manchester, July 18, 1856, from the practice of the Berwickshire Naturalists' Club in Scotland. Shall they be revived? It is not unlikely that a practical test will be applied this summer, in the form of invitations to visit two or three attractive localities. In that case it will devolve upon the field-meeting committee, which has been a sinecure for several years past, to determine how far under the greatly changed conditions now existing — when so many towns, twelve at least, have local societies of their own, and when facilities for travel are vastly increased and extended, — the attempt to revive field-meetings is expedient and practicable.

Donations have poured in upon us in such volume as to tax the utmost capacity of our available space; and a generous rear-extension of our building has become as

necessary for the accommodation of the normal, daily growth of the collections as it is indispensable, if we would provide for large donations already promised and secure such as our lack of space may, it is feared, be diverting to some other destination.

Our lack of funds is actual and not prospective and no donor, who has money to devote to the interests of general culture, could do better than by endowing us with a portion of his bounty.

Among the gifts received this year, are six volumes of elegant engravings of the details of East Indian architecture, presented by the Maharaja of Jeypore, with splendid illustrations of American architecture from another source; a donation of rare value and interest from Henry Fitz Gilbert Waters, including a copy of Robinson Crusoe's will; a Hebrew Bible enclosed in a case measuring $1 \times 1\frac{1}{4}$ inches and worn in Russia as a watch-charm; a complete Parsee presentation costume: a photograph of an ancient knife handle richly embossed, once the property of William Burnet Browne of Salem and Virginia, and now in possession of a descendant alike of his and of the Washington family; large donations of books, specimens and curious articles of household and personal convenience from the estates of George D. Phippen, William Mack, John Pickering and Miss Bemis; portraits of Samuel Webb, of Benjamin Wheatland and wife, of Dr. Bentley, of the philologist Pickering and other worthies. In addition to which some effort has been made to save to the future some of the vanishing landmarks of our day. Miss Brooks has presented the Institute with a picture of the old Union Insurance Building which stood looking down Market, now Central street, until 1836, and the Institute has secured drawings by Mr. George E. Browne of the old Eastern Railroad Station, of the West Gate of the Common, of the historic toll-house and draw

of Essex Bridge, of Washington's visit to the North Beverly Cotton Mill, and of the Browne mansion on Folly Hill in Danvers. The acquisitions of the year are so varied, so numerous and so valuable that it is unsafe to particularize among them to the exclusion of any. The forthcoming Secretary's report must be awaited if justice is to be done them.

In closing this report it remains for the committee to give voice to the obligations of the Institute for the very cordial support from the people of this community of which it has been sensible throughout the year. If this is, as it seems to be, an evidence of an appreciative recognition of its work and an earnest, unabated confidence in its future, the friends of the Institute may well take it as a guarantee of coming prosperity. Though our needs are greater to-day than ever in the past, our claims are seen to rest upon successes in a wider field and based upon a firmer footing.

Report of the Secretary, for the year ending May 17, 1897.

The very full report of the Executive Committee makes it almost superfluous for me to add anything except, perhaps, a few statistics which it has been usual for the Secretary to furnish every year for the annual meeting.

The donations to the cabinets the past year have been 455, from 115 different donors.

11,035 persons, according to our record, have visited the old meeting-house; but, as many people go in at the gate without making their appearance in our room, it would be safe to say, there must have been at least twenty-five per cent. more visitors than we have a record of. We have to spend a great deal of time answering the usual batch of questions, such as — "Is this key the

original one?" "Was the church Baptist?" Even some Rhode Island people have not yet learned that Roger Williams was never much of a Baptist, and that he finally went back to the church of England. Nor can they understand that Salem people *did not* persecute him. These things have to be explained over and over again. What Historical Society in this country has to make so many explanations as have we? We furnish a printed itinerary to visitors which, of itself, causes them to ask a multitude of questions, as to the distance of each place, and the direction, and how long it will take to reach it, and where a good lunch can be found, and can we furnish them with a glass of water, etc. A gentleman, who happened to be listening the other day to some strangers asking numerous questions, said to me, "Is this the Bureau of Information?" It would be amusing, if I had the time, to record all the questions asked. Seriously, I fear the Directors do not consider how much time these endless explanations take. Unless a person can be thinking of three or four different things at once, it is almost impossible to write even a letter in the Secretary's room, some of these summer days. I think it is desirable to have strangers visit our rooms and examine our collections, but I do not think the whole work of the Institute should be sacrificed to this business of explaining all that is to be seen in Salem.

The following members have died during the year: Hon. John I. Baker, of Beverly, Willard H. Brown, Rev. Caleb Davis Bradlee, of Boston (life member), James Buxton, of Peabody, Benj. S. Calef, of Boston, Rt. Rev. A. C. Coxe, of Buffalo, N. Y., G. Winthrop Coffin, of Boston, Frank T. Dalrymple, Perley Derby, Miss Mary Abigail Dodge, of Hamilton, Wm. J. Foster, Prof. D. B. Hagar, Miss Mary L. King, Miss Mary I. Lefavour, Wm. Henry Lovett, of Beverly, Hon. John

Lowell, of Boston, George E. Pearson, Hon. Stephen H. Phillips, Rev. A. H. Quint, D.D., of Boston, Arthur S. Rogers, A. A. Sawyer, Michael W. Shepard, Geo. F. Sibley, James J. Storrow, of Boston, Francis Tuckerman, Mrs. Mary A. Turner, of Marblehead, Miss Anna E. Ticknor, of Boston, Chas. P. Trumbull, of Beverly, William L. Vinal.

From various causes there have been a number of withdrawals of members the past year. Some from pecuniary reasons, some by removal from town; some have left us on account of the historical societies formed in their own towns which, naturally enough, they wish to encourage, rather than the Institute; others for decline in interest in historical matters; others perhaps have become more interested in the bicycle, which seems to affect almost every kind of business. All these, together with the deaths named, have somewhat reduced our membership. It will be necessary for us to be continually recruiting to make up such losses, to which we are always liable.

I would recommend that a committee be appointed, of perhaps three persons, to be called a "Committee on Membership," to take charge of this matter, and advise with the Secretary from time to time as to the best course to be pursued to keep our numbers as large as possible.

In conclusion, I have only to say, that the Society has been unfortunate the past year in having so much sickness among its assistants; but through the active personal attention of its President, the work has gone on remarkably well, and now all that is really needed is the room and funds necessary to greatly increase its usefulness.

Which is respectfully submitted,

HENRY M. BROOKS,
Secretary.

Report of the Librarian.

The additions to the library for the year (May, 1896 to May, 1897), have been as follows:

By Donation.

Folios,	77
Quartos,	97
Octavos,	1,239
Twelvemos,	813
Sixteenmos,	301
Twenty-fourmos,	80
Total of bound volumes,	2,607
Pamphlets and serials,	5,426
Total of donations,	8,033

By Exchange.

Folios,	5
Quartos,	7
Octavos,	193
Twelvemos,	1
Total of bound volumes,	206
Pamphlets and serials,	1,517
Total of exchanges,	1,723

By Purchase.

Folios,	1
Quartos,	2
Octavos,	7
Total of bound volumes,	10
Pamphlets and serials,	7
Total of purchases,	17
Total of donations,	8,033
Total of exchanges,	1,723
Total of additions,	9,773

Of the total number of pamphlets and serials, 3,189 were pamphlets and 3,761 were serials. The donations to the library for the year have been received from 164 individuals and 113 societies and governmental departments. The exchanges, from 13 individuals and 247 societies and incorporated institutions, of which 115 are foreign.

The library year has been a very uneventful one. Our pressing needs of more stack-room for books, and a catalogue, are no nearer attainment than they were a year ago, except perhaps as each year brings us nearer the time when those wants must be supplied.

Our work this year has been seriously hampered by sickness. The assistant librarian, Miss Mary E. Arvedson, was obliged to relinquish her work and seek rest and change, and it is doubtful whether she will feel that she can take it up again. Her loss is a serious one to the Institute. Familiar, as she was, with the contents of the library, she was of great assistance to all who sought access to it, and this familiarity, the result of years of faithful service, we shall miss for a long time in any successor. Miss Waters has also been absent for a long period on account of sickness, but it is hoped that before long she will be able to return to her duties. Miss Bartlett has resigned, not on account of sickness, but to assume new duties and responsibilities, and this has left us with inexperienced assistants who, however efficient and faithful they may be, cannot at once make good the places thus left vacant.

All this, however, has not seriously interfered with the use of the library, which has been very satisfactory. The pleasant rooms of the Institute are always open to students and investigators in any branch of literature or science, as well as to the general reader, and such assistance as we can render is gladly and willingly given.

Although somewhat crippled by what seems to be more than our share of sickness, including that of our genial secretary whom we all hope to welcome back to his labors before many weeks, the Institute never falters in its good work. Sickness and death make but a momentary halt in its progress. The gaps are quickly closed and the work

goes on as before. Year by year what is being done to preserve the traditions, and perpetuate the history of county and city is more and more appreciated. Let us make sure that when we are called upon to give the conduct of the Institute into other hands we may be able to give a good account of our stewardship.

CHAS. S. OSGOOD,
Librarian.

TREASURER'S REPORT.

RECEIPTS.

Balance from last report,		$345 15
Received from invested funds,	$3,254 38	
" " assessment of members,	2,166 00	
" " life membership fees,	50 00	
" " publications,	260 28	
" " Almy, Bigelow & Washburn, for		
" " "Reception Fund,"	25 00	
" " Sam'l A. Carleton, for "General Fund,"	32 00	
" " other sources,	202 68	5,990 34
		$6,335 49

EXPENDITURES.

Salaries of secretary, assistant librarians and janitors,	$2,277 32	
Fuel,	197 75	
Lighting and water,	110 96	
Postage and express,	189 50	
Supplies,	102 40	
Lecture expenses,	34 00	
Books,	331 06	
Publications and printing,	1,214 09	
Our proportion of Athenæum expenses,	318 90	
Annuities,	610 00	
Interest on loan,	197 19	
Storage warehouse,	37 80	
Repairs on building, etc.,	352 57	
Framing pictures,	30 50	
Reception expenses,	143 60	
Miscellaneous,	38 75	$6,186 39
Balance of cash on hand,		149 10
		$6,335 49

Respectfully submitted,

W. O. CHAPMAN, *Treasurer.*

Auditor's Report.

Salem, May 17, 1897.

Your auditor respectfully reports that he has examined (on May 15, 1897) the securities detailed in the treasurer's report and finds them to agree with the schedule by him presented herewith.

By the treasurer's annual report of receipts and expenditures, the books of account appear to be properly and systematically kept, and the usual vouchers filed.

H. M. Batchelder,

Auditor.

Lectures and Meetings.

Regular Meeting, Monday, June 15, 1896. — The President spoke of the seventy-fifth anniversary of the founding of the Essex Historical Society which would occur in September next and of the fiftieth anniversary of the Essex Institute which would occur in two years and hoped that notice would be taken of both of these events.

He also referred to the probable loss to our Society of Prof. D. B. Hagar, who was soon to remove from town.

Monday, June 22, 1896. — A meeting of the Directors was held at the rooms this afternoon at 3 o'clock. The President called attention to the seventy-fifth anniversary of the old Essex Historical Society, which occurs this year, and suggested that notice should be taken of this event by the Society. It was voted that the matter be referred to the Executive Committee with full powers.

Mr. T. F. Hunt referred to a recent gift of valuable books from the Maharaja of Jeypore, India, and it was voted that the President and Secretary send a letter of thanks to His Highness for this favor.

The letter was as follows: —

JUNE 27, 1896.

The Essex Institute has, by vote of June 22, 1896, directed us to communicate

To His Highness,
The Maharaja Sawai Madhu Singh, G.C.S.I.,
of Jeypore, Rajputana, India,

the very high sense of obligation and gratitude entertained by the Institute for the princely gift of six folio volumes of the "Jeypore Portfolio of Architectural Details," lately received through the generosity of His Highness and placed upon our shelves.

Such an addition to our art-collection comes most opportunely at a time when the architectural wealth of India is more than ever before attracting the deserved attention and admiration of the modern world, and when the matter of elegant decoration in wood, metal and stone is being studied and pursued with an interest at once quite new to America and not unworthy of the antique spirit for domestic adornment which has inspired the art work of India for ages before this western world began.

May we be permitted to add that it seems fit that Salem, before all other cities of this continent, should be favored with the consideration of His Highness, who may well have been influenced in the distribution of his bounty by a knowledge of the fact that Salem ships were pioneers in the commercial intercourse between India and America, and that Salem merchants and navigators who, in large measure, sustained for years the amicable relations subsisting between these countries, established here a social and charitable fraternity known as the East India Marine Society and gathered here a collection of Oriental art-treasures and curiosities without a rival in America.

We beg His Highness to be assured that the magnificent portfolio of Indian art could have been placed in no library where it would challenge more general appreciation or more heartfelt thanks. And we beg to submit herewith an impression of our city seal, upon which His Highness will read, we trust not without interest, the motto:

"*Divitis Indiæ, usque ad ultimum sinum.*"

Captain Whipple spoke in terms of interest of the fact of Mr. Hagar's change of residence and of his resignation as principal of the State Normal School in this city, and it was

Voted: That the Essex Institute gives voice to the universal sentiment pervading this community when it records the sense of deep regret with which the withdrawal of Vice-President Daniel B. Hagar from his post at the State Normal School in Salem has been received.

Coming amongst us as a well-known and accomplished teacher, Mr. Hagar has, for a whole generation, kept the important institution entrusted to his charge in touch with the best educational influences and ideas of the day. By virtue of a rare personality he has been able to mould it to his own intelligent and high ideals and, by assiduous devotion and care, he has made it an honor to the County of Essex and a model amongst the academic establishments of the State.

Although weighted with this load, he has not failed to respond to the various calls of American citizenship upon the time and energies of the well-disposed, but has borne a full and willing share in every social, political and municipal concern; especially has he held himself ready for every service which the Institute could fairly and reasonably demand. It will be no easy task to fill the place left vacant by the withdrawal of Mr. Hagar.

Voted: That the President, with Messrs. Whipple and Osgood, be a committee to communicate to Mr. Hagar these sentiments of regard and esteem expressed by the Directors, and to tender to him, in the name of the Essex Institute, some general recognition of his eminent services to the county, embodied in such form as may be most consonant with his feelings and wishes.

To this vote, duly communicated to Professor Hagar,

the following reply was received, addressed to Capt. George M. Whipple of the Committee.

JAMAICA PLAIN, MASS.,
JUNE 24, 1896.

MY DEAR CAPT. WHIPPLE,

I most gratefully appreciate the kindness of the Directors of the Essex Institute as expressed in their resolutions with regard to my departure from Salem. I am profoundly thankful for this evidence of friendly regard.

I exceedingly regret that the condition of my health must debar me from meeting the Directors at an informal dinner or at a reception. Were I in good physical condition it would be a delight to me to meet the members of the Institute and to discourse upon its welfare.

Please present my thanks to your associates of the committee on resolutions relating to myself, and accept for yourself my grateful acknowledgment.

With sincere wishes for the prosperity of the Essex Institute,

I remain, yours truly,
DANIEL B. HAGAR.

Regular Meeting, Monday, July 20, 1896. — It was voted to amend the By Laws, Article II, Section 2, relating to the election of officers, in the second line, by adding after the word "Society" these words, "together with a finance committee," as provided in Section 7, of the Charter of the Essex Institute.

At a meeting of the Executive Committee held this day it was voted, That the Institute celebrate the seventy-fifth anniversary of the founding of the Essex Historical Society, and that the President be requested to prepare an address to be delivered on the occasion.

Regular Meeting, Monday, Aug. 17, 1896. — Mr. George R. Curwen offered the following resolutions:

Resolved: That the Essex Institute records with sorrow and deep regret, the death at Sharon, on the 4th instant, of Daniel Barnard Hagar, a Vice-President of the Society since 1873, the Principal of the State Normal School of Essex County since 1865, and a citizen of Salem greatly endeared to this community by his life-long fidelity to the highest trusts.

If a career of loyal service to important interests, — of ready helpfulness to others and consideration of their needs, — of public-spirited devotion to the general good, deserves to be remembered and applauded, the life just closed is worthy of it all.

Friday, Sept. 18, 1896. — The seventy-fifth anniversary of the founding of the Essex Historical Society was celebrated this day by the Essex Institute. A meeting was held in Academy Hall, at 3 o'clock, before which Hon. Robert S. Rantoul delivered a commemorative address which will be printed in pamphlet form.

After the exercises the company adjourned to Plummer Hall, where an informal hour was spent in social intercourse.

Regular Meeting, Monday, Oct. 19, 1896. — It was

Voted: That the Essex Institute receives with gratitude and thanks, at the hands of its life-long patron and contributor, Henry Fitz Gilbert Waters, a donation of rare value and interest, consisting of a Madonna, painted in the manner of Murillo; an ancient Italian marriage coffer or *cassoné*, richly carved in black oak; two chairs of unique design, one 15th century English, the other Italian and older; and two very rare and beautiful specimens of antique cut glass, — the whole forming a

promising foundation for the art collection, which it has long been the hope of the generous donor, as well as of the Essex Institute, to see growing up in Essex County.

Voted: That a copy of this vote be sent to Mr. Waters.

Regular Meeting, Monday, Dec. 21, 1896. — The Secretary read a letter received from the three sons of the late George Dean Phippen, tendering to the Society their father's collection of books, shells, minerals, etc.; and, on motion of Mr. George L. Peabody, it was

Voted: That the generous offer this day received of books from the library of the late George Dean Phippen, together with a considerable collection of shells and minerals, an herbarium accumulated by that enthusiastic and untiring student of nature, and a framed likeness of the late Samuel Webb, a life-long member of the Natural History Society of Essex County, — be accepted with thanks.

Voted: That the donation be preserved as a fitting memorial of our first librarian, who lived to be the last survivor of the seventeen original members of the board of government of the Essex Institute.

Voted: That a copy of the above be forwarded to the family of Mr. Phippen.

Monday Evening, Jan. 4, 1897. — Regular meeting in the Library room. Mr. William L. Welch spoke of the history and topography of the Salem Neck, showing from a large map the different points of interest. He thought that the inlet between Winter Island and the Juniper was "Winter Harbor" as described in deeds, etc., and not, as has been commonly supposed, the water between Winter Island and that part of the Neck bounded by Hathorne's point, now called Cat Cove. Butt Point, where the first ferry started for Marblehead, was near the

Point of Rocks at Hathorne's Point. Later, the ferry landing was at the foot of Turner street. Mr. Welch, having been for many years a resident on the Neck, and most familiar with that locality, presented many important facts.

Extended discussion followed by Mr. Henry F. Waters and other members. This paper is in print.

Monday, January 11, 1897. — The first lecture in the "free course" was given this evening, in Plummer Hall, by Prof. George L. Goodale of Harvard University; subject, "New Zealand," illustrated with lantern views. Vice-President Edward S. Morse presided and, before introducing the lecturer, read the following paper offered by the Executive Committee.

The Executive Committee of the Institute respectfully submits this expression of sentiment to the consideration of the members here assembled.

Voted: That the Essex Institute would add its voice to the patriotic demand for preserving what remains to us of the Frigate Constitution.

No sentiment of the heart is more worthy of encouragement than the love of country, and in no way can the sentiment be cherished more effectively than by consecrating and handing down the memorials of distinguished patriotic devotion and daring.

The story of the Frigate Constitution is embalmed in history and song. No war-ship ever bore our country's flag more bravely. No nobler war-ship ever bore — as the enemies of the country can attest — the flag of any nation. Her career was one of unchecked triumph.

If citizens are to be taught that gallantry in the defence of the nation's rights will be forever honored, — if those who venture life and fortune on the deep are to be assured, hereafter, that the strong arm of the nation is everywhere

and at all times around them,— if young heroes are to be raised up to fill the posts left vacant by those who already crowd the Valhalla of the nation's glory, — it would seem that the Frigate Constitution should be preserved as an object-lesson in patriotic daring, so long as a bolt remains which was once the instrument of achievements destined never to be forgotten.

The votes were adopted.

Professor Goodale spoke of the location of New Zealand, which consists of three islands, North Island, Middle Island and South or Stewart's Island. Total area about 100,000 miles, or nearly as large as Great Britain. The climate is as varied as that of North America. The vegetation is very luxuriant, all the native plants being evergreen. The geological formations were described by the lecturer as extraordinary to the scientist. The islands are of volcanic origin and a great portion of the total area is occupied by mountains among which are many extinct and some active volcanoes. Many of the streams are of hot water, powerfully charged with mineral properties, which form deposits on the rocks and other objects in their course, affording very beautiful effects.

There are about 40,000 of the aboriginal tribes now living. While their moral standard is somewhat different from that of the people of the United States, yet they have proved to be brave, generous and truthful. The colonists outnumber the aborigines three to one.

Pictures were shown of the town of Christchurch, one of the chief ports. The educational institutions of the colonists are of the highest class.

At this opening lecture Plummer Hall was crowded and many persons came to the door who were unable to get in.

Monday Evening, Jan. 18, 1897. — Regular meeting in the Library room. Mrs. W. S. Nevins, of the Local

History Class, read an interesting paper on some of the early colonial magistrates, speaking principally of William Hathorne, Emanuel Downing, John Humphrey and George Downing, the latter being the second graduate in the first class of Harvard College.

Miss Helen D. Lander then read a paper prepared by Mrs. Henry Wardwell, on Salem Village. These papers were well written and of great interest and were discussed by the President and some other members.

Monday Evening, Jan. 25, 1897. — Hon. Thomas J. Gargan, of Boston, lectured in Plummer Hall on the "Boston Subway." He spoke of the great need of some way of relieving the crowd in the narrow streets of Boston. He gave an account of some European subways, showing the Boston one to be much larger and more convenient than any abroad. With lantern slides he exhibited views of the plans and mode of its construction and probable working when completed, and the condition the Boston streets will be in at that time, especially Tremont and Boylston streets.

Monday Evening, Feb. 1, 1897. — Regular meeting in the Library room. Mr. John Robinson gave an interesting and instructive talk on "Mushrooms, Edible and Non-edible." He exhibited many specimens, with illustrations on the blackboard. Rules were given, so far as it is possible to give rules, for the gathering of mushrooms. The extremely nutritious character of some kinds, and the difference between those excellent fungi and the poisonous toad-stool were noted. Some canned and some dried specimens of Italian and other kinds were exhibited, which emitted a peculiar odor.

The subject was discussed by the President, Professor Morse, Dr. Merriam and others.

Monday Evening, Feb. 8, 1897. — Prof. Arlo Bates, of the Institute of Technology, Boston, lectured in Plummer Hall on "The Language of Literature." He began his lecture by referring to the fact that all language is a system of conventions. If we do not understand the convention we are not able to communicate with the individual using it. This principle holds good in music as well, as is shown in the difference between European and Chinese music for example. The latter, a jumble of unmelodious sounds to our ears, to the Chinese conveys sentiment and deep meaning. The poet also has a language of his own, one far removed from the ordinary speech of every-day life, one by which he can express the emotions and phases of feeling, which we try in vain to put into words. The poet's genius consists in this, that he turns his hearers, ordinary men though they are, into poets for the time being; makes them see with his eyes and, by some luminous phrase, lifts them to something of his own level of inspiration. Similes form a great part of our language, often distorted, perhaps robbed of their original meaning, yet full of suggestion to the student. Such a word is "backer," originally used to denote the one who stood back to back with you in the fight, warding off all blows from that side. The language of literature is full of allusions which must be understood to get from it the meaning which should be there. These allusions may be classical, historical, mythological, allusions to folk-lore or to literature itself. Examples of all these readily present themselves. Our ancestors read and re-read their treasured volumes of the classics, and our speech is full of references to persons and situations found therein. History has given us much that we use without thought, but cannot fully understand without having in mind the especial event or person

referred to. Folk-lore allusions, as Milton's when he speaks of the "Lubber Friend" or "Lob lie-by-the-Fire," are perhaps less common, yet not infrequently met with. Robert Browning, of the modern poets, refers most often to out-of-the-way lore of this sort, a habit which gives some color to the oft-repeated complaints of his obscurity. The Bible has left a deeper impress on our literature than any one factor. We owe more than we often realize to the stately language and dignified expressions of the King James version.

Monday Evening, Feb. 15, 1897. — Regular meeting in the Library room. Mr. Arthur H. Chase read a very entertaining paper on "Every-day life in Paris." The speaker said that it had been generally held by Americans that there was no home life in Paris, but it is a great mistake to suppose that there is no home feeling there, for in reality it is just the reverse. Home is as much cherished as it is in England or America. Mr. Chase, having lived many years in Paris, had excellent opportunities for observing the manners and customs of the people. He described Sunday, which, although not kept with the strictness that it is in England or in the United States, after morning services in the churches, was more a day of family gatherings and rational enjoyment. In concluding his remarks Mr. Chase said that the two best places in the world in which to live are Salem and Paris. Discussion followed.

Monday Evening, Feb. 22, 1897.—The fourth lecture in the course was given this evening in Plummer Hall, by Prof. Charles S. Minot, of the Harvard Medical School, Boston. His subject was "von Baer, the Greatest Russian Naturalist," which proved to be very interesting.

Monday, March 1, 1897.—Regular meeting of the Society this evening in the Library room. Gilbert L. Streeter, Esq., read an elaborate paper on "Salem Neck and Winter Island." The speaker said that Winter Island contains but thirty-six acres, but has a great history. The place was first visited by white men in 1614. Captain John Smith called this section Bass-town and Bass-table because of the abundance of bass in the bay at that time. The Indians here were more fishermen than hunters. Some early families of Salem settled on the Neck, and Winter Island was the centre of the fishing business. The present causeway between the Neck and the Island was built as early as 1637. There were places for forty vessels to land fish at one time. The wharves were on the inner side.

The road now running to the Fort was a street called Fish street. There were houses towards Salem along the shore, and the cellars have been visible within the memory of people now living. The settlement on the neck at that time was called Watertown. There was an inn kept by John Clifford on the island. In after years the Neck became a place for ship-building. The famous "Frigate Essex" was built here near the close of the last century. The first fort on Winter Island was begun in 1643. In 1699 it was known as Fort William. In 1794 it was ceded to the United States, and in 1799 named Fort Pickering, and on being rebuilt was considered one of the best fortifications on the coast. Winter Island has been used as a camping ground for militia at times, since 1853.

The paper is printed in the Historical Collections.

Monday Evening, March 8, 1897.—Curtis Guild, Jr., of Boston, lectured in Plummer Hall on "The Sword in Warfare."

General Guild traced the development of the sword from the first form, which somewhat resembled an axe, to the sword of the present day. He illustrated the subject by exhibiting a large and rare collection of swords of nearly every kind and period since the weapon was first known. Among numerous others, there were a rapier of the time of Queen Elizabeth, and a claymore such as is described by Sir Walter Scott in the "Lady of the Lake," —a sword used by General Stark, in the war of the Revolution, and two ancient Japanese swords belonging to Prof. E. S. Morse. The swords provided for officers of the American army were simply "dress swords" and not designed to be used like those of cavalry soldiers, the latter being powerful weapons. The sword, he said, has never been used as had the dagger, the revolver or the bludgeon, as the weapon of the murderer, but only as the weapon of the soldier.

Monday Evening, March 15, 1897.—Regular meeting in the Library room. Mr. Edward A. Silsbee, formerly of Salem, gave a most entertaining talk upon foreign experiences and life, extending over a long residence in Europe and Asia. He called his subject "Internationalism" and, while applauding the charms and discoursing of the advantages of life in foreign countries, summed up with the verdict that the older he grew the more persuaded he was that America was the country to live in. This was one of Mr. Silsbee's unique productions: quite impossible to report. He said among other things that he told an Englishman the best thing his country ever did was "to produce us!" Referring to our own country, he thought we must rediscover the imagination, before we could have any great poets. Wealth will not make them.

Meeting in Plummer Hall, Monday, March 22, 1897. —At a meeting of the Essex Institute, holden at Salem, March 22, 1897, the following vote was adopted:

Voted, That, in the judgment of the Essex Institute, the tract of land overlooking Gloucester Harbor and at various times known as "Stage Fort," "Stage Head," and "Fisherman's Field," is a fitting location to be acquired by the Commonwealth of Massachusetts as and for a State Park.

Its history entitles it to recognition. As early as the winter of 1623–4, a group of pioneers began a fishing plantation there. A part of them, in 1626, moved up the shore to Naumkeag, and effected the settlement which, reinforced by Endecott and his party in 1628, and by Higginson and his party in 1629, became Salem in July of the last named year, and was the foundation of the Colony of Massachusetts Bay.

In honor of the Chief of these pioneers, the War Department, at the suggestion of the Institute in February, 1864, gave to the works then projected at this point to supplant the ancient Revolutionary defences of Gloucester Harbor, the name of "Fort Conant." The Sheffield patent of 1623, under which these settlers claimed, provided for a compact town on the water-side of Cape Ann Bay,—each planter to have thirty acres in severalty,—and five hundred acres of common land along the Bay to be devoted to the public uses of schools, churches, hospitals, and the maintenance of ministers, magistrates, and other town functionaries,—a typical New England village, worthy for its own sake of a lasting memorial.

No spot is more closely than this identified with the origin of Massachusetts. Its picturesque and uneven surface would well meet the demands of landscape gardening,—its unrivalled ocean outlook makes it the ideal of

a seaside resort, whilst its location within easy reach of a vigorous and growing city would give to the reservation a practical value for the health-dispensing uses of a public park.

Rev. E. D. Towle, of the East Church, Salem, read a paper on Dr. Oliver Wendell Holmes, and his spirited recitation of some of the poet's best work, interspersed in the hour's reading, added greatly to the enjoyment of the evening.

Monday Evening, March 29, 1897.—Professor Ripley, of the Massachusetts Institute of Technology, lectured in Plummer Hall, on "Some Peculiar People of the South of France," illustrating his remarks with maps and a large number of drawings of heads taken from life, showing the typical features and formations. He had discovered, in southern France, a little isolated population which seemed to have remained pure and unmixed almost from prehistoric times.

Monday Evening, April 5, 1897.—Regular meeting in the Library room. Miss Warner, of the Low School, gave one of her delightful bird-talks on the early comers which appear in April in our fields and hedges. The address was illustrated with stuffed specimens from the collections of the Peabody Academy of Science and was very fully reported in the Salem Gazette for April 6, 1897.

Monday Evening, April 12, 1897.—Louis Prang, the creator of chromo-lithography in America, lectured in Plummer Hall, giving an exposition of his process, illustrated with numerous products of his popular art. Mr. Prang prefaced his paper with a somewhat detailed and very interesting account of his personal experiences and struggles in building up the great business which has

made the world his market and made him one of the world's benefactors, in that he has brought fine-art products down to a price within the reach of the humblest. If he allowed himself to accept any praise, he said it was as one who had popularized good art.

Monday Evening, April 19, 1897.—Regular meeting in the Library room. There was offered for consideration a letter from "The Academy of Natural Sciences" of Philadelphia, calling attention to a meeting of the International Postal Congress to be held in Washington, D. C., on May 5, 1897, to consider, among other subjects, an amendment to the present postal laws, "which will admit specimens of natural history to the mails at the rate for samples of merchandise, that is to say, at one cent for every two ounces."

The Academy of Natural Sciences of Philadelphia had adopted resolutions approving of the proposed amendment, and requesting the Essex Institute to adopt similar resolutions and send them to the Postmaster-General at Washington.

The following resolutions to that effect were offered and unanimously adopted:

Resolved: That the Essex Institute heartily concurs in the action taken by the Academy of Natural Sciences of Philadelphia, recommending to the coming International Postal Congress, at the instance of our Sister Republic of Switzerland, a reduction in the rates of postage upon mailable specimens in Natural History to the rates imposed upon samples of merchandise, the same to affect the mail service of the Universal Postal Union.

Resolved: That the Essex Institute respectfully urges the amendment, to be proposed by the Swiss Government, upon the favorable consideration of the Postmaster-Gen-

eral of the United States, and of delegates to the International Postal Congress, about to sit at Washington.

Mr. Ezra D. Hines, of Danvers, read an interesting and instructive paper entitled, "Some Danvers Acres." After a few introductory remarks, the speaker said that in early times the measure of an acre of land was what a man and a pair of oxen could plow over in a day. The acres that Mr. Hines referred to in his lecture were located in Danvers, as the title shows, and settled upon and improved by the founder of the Putnam family, many of whose descendants now live in the immediate neighborhood. He said this family had produced many distinguished men, each generation, down to the present time, furnishing its quota. He paid a glowing tribute to Col. Timothy Pickering, who at one time lived on and worked some of those acres. He also referred to our townsman William A. Lander, who for more than thirty years lived on one of those farms, and greatly improved and beautified it by setting out a large number of shade trees, some of which were not natives of these parts, and they are still standing. He also spoke of the poet Whittier, as having lived at Oak Knoll, a place built and improved by Mr. Lander, so named from the fact that many beautiful oak trees grew there. It was at Oak Knoll that Whittier wrote many of his later poems.

After the lecture Mr. Hines exhibited some photographs of houses connected with these acres, one being the fine old Putnam homestead which is still standing.

Monday Evening, April 26, 1897.—Rev. John W. Buckham, of the Crombie Street Church, was to have lectured in Plummer Hall, on "Old Time Salem Clergymen," but at a late hour a note was received announcing the illness of the speaker and no meeting was held.

Monday Evening, May 3, 1897.—Dr. Hasket Derby, of Boston, delivered an illustrated lecture in Plummer Hall, on "A Dead City of the Baltic." This was Wisbuy, the capital of the Island of Gothland, which belongs to Sweden. The speaker had been there and brought away some sixty-five slides and many delightful impressions. It was once the great commercial port of northern Europe, grew vastly rich, built splendid warehouses and churches, and established five hundred years ago a maritime code, quoted ever since as the "ancient and supreme water-law of Wisbuy" and commended by Grotius as of the highest authority almost all over Europe. All that remains of the once "magnificent city of Wisbuy" are the wealth of architectural ruins to be seen there and this wonderful code of laws. Grass grows in the streets and the harbor is deserted. In 1361, Valdemar, a Danish conqueror, sacked the city.

Necrology of Members.

John Israel Baker, son of Joseph and Lucy (Bisson) Baker, was born in Beverly, Aug. 16, 1812; elected a member of the Essex Institute, June 18, 1851 and died in Beverly, Feb. 17, 1897.

Rev. Caleb D. Bradlee, D.D., son of Samuel and Elizabeth D. (Williams) Bradlee, was born in Boston, Feb. 24, 1831; elected a life member of the Essex Institute, Sept. 4, 1894 and died in Brookline, May 1, 1897.

Willard H. Brown, son of Edward and Eunice (Porter) Brown, was born in Plaistow, N. H., Apr. 24, 1823; elected a member of the Essex Institute, Nov. 4, 1879 and died in Salem, May 21, 1896.

James Buxton, son of Amos and Mary (Stone) Buxton, was born in Danvers (now Peabody) Sept. 3, 1832;

elected a member of the Essex Institute, July 23, 1884 and died in Peabody, Feb. 10, 1897.

Benjamin S. Calef, son of John and Rebecca (Shreve) Calef, was born in Saco, Me., Jan. 21, 1835; elected a member of the Essex Institute, Sept. 17, 1894 and died in Boston, Jan. 9, 1897.

G. Winthrop Coffin, son of —— and——(——) Coffin, was born in ——, ——; elected a member of the Essex Institute, July 15, 1895 and died in Aix le Bain, France, Aug. 9, 1896.

Rt. Rev. A. C. Coxe, D.D., son of Rev. Samuel Hawson Coxe, was born in Meadham, N. J., May 10, 1818; elected a member of the Essex Institute, Feb. 3, 1896 and died in Buffalo, N. Y., July 20, 1896.

Frank T. Dalrymple, son of James and Mary A. (Flint) Dalrymple, was born in Salem, Oct. 7, 1851; elected a member of the Essex Institute, July 18, 1887 and died in Salem, May 17, 1897.

Perley Derby, son of Charles and Nancy (Pulling) Derby, was born in Murfreesboro, Tenn., Oct. 26, 1823; elected a member of the Essex Institute, Mar. 8, 1856 and died in Salem, Mar. 28, 1897.

Mary A. Dodge, daughter of James B. and Hannah (Stanwood) Dodge, was born in Hamilton, Mar. 31, 1833; elected a member of the Essex Institute, May 7, 1894 and died in Hamilton, Aug. 17, 1896.

William J. Foster, son of William H. and Laura A. (Ward) Foster, was born in Salem, Aug. 4, 1835; elected a member of the Essex Institute, Feb. 25, 1856 and died in Salem, May 12, 1897.

Daniel B. Hagar, son of Isaac and Eunice (Steadman) Hagar, was born in Newton Lower Falls, Apr. 22, 1820;

elected a member of the Essex Institute, Aug. 9, 1865 and died in Sharon, Aug. 4, 1896.

Mary L. King, daughter of James B. and Mary J. (Fabens) King, was born in Salem, Aug. 11, 1845; elected a member of the Essex Institute, Apr. 30, 1894 and died in Salem, Apr. 3, 1897.

Mary I. Lefavour, daughter of John W. and Emily G. (Hollister) Lefavour, was born in Salem, May 25, 1858; elected a member of the Essex Institute, Mar. 21, 1892 and died in Salem, Mar. 29, 1897.

Caleb W. Loring, son of Charles Greeley Loring, was born in Boston, July 31, 1819; elected a member of the Essex Institute, Sept. 4, 1894 and died in Boston, Jan. 29, 1897.

William H. Lovett, son of Benjamin and Huldah (Lewis) Lovett, was born in Beverly, Dec. 5, 1853; elected a member of the Essex Institute, Aug. 1, 1887 and died in Beverly, Aug. 18, 1896.

John Lowell, son of John A. and Susan (Cabot) Lowell, was born in Boston, Oct. 18, 1825; elected a member of the Essex Institute, Jan. 6, 1896 and died in Chestnut Hill, May 14, 1897.

George E. Pearson, son of Leonard M. and Henrietta (Lancaster) Pearson, was born in Boston, June 18, 1843; elected a member of the Essex Institute, June 18, 1894 and died in Salem, Oct. 28, 1896.

Stephen H. Phillips, son of Stephen C. and Jane A. (Peele) Phillips, was born in Salem, Aug. 16, 1823; elected a member of the Essex Institute, May 8, 1850 and died in Salem, Apr. 8, 1897.

Rev. Alonzo H. Quint, son of George and Sally W. (Hall) Quint, was born at Barnstead, N. H., Mar. 22,

1828; elected a member of the Essex Institute, Nov. 18, 1895 and died in Boston, Nov. 4, 1896.

Charles E. Rea, son of Samuel and Sarah Ann (Webster) Rea, was born in Portsmouth, N. H., Oct. 12, 1845; elected a member of the Essex Institute, Nov. 18, 1895 and died in Danvers, May 1, 1897.

Arthur S. Rogers, son of Richard S. and Sarah (Crowninshield) Rogers, was born in Salem, Dec. 14, 1835; elected a member of the Essex Institute, May 7, 1894 and died in Salem, Feb. 8, 1897.

Addison A. Sawyer, son of Moses and Hannah M. (Rowell) Sawyer, was born in Amesbury (now Merrimacport) Aug. 23, 1834; elected a member of the Essex Institute, Jan. 15, 1894 and died in Salem, Nov. 26, 1896.

Michael W. Shepard, son of Michael and Harriet F. (Clarke) Shepard, was born in Salem, Feb. 28, 1826; elected a member of the Essex Institute, Mar. 4, 1895 and died in Salem, Dec. 2, 1896.

G. Frederick Sibley, son of George and Josephine M. (Ayers) Sibley, was born in Salem, Oct. 15, 1871; elected a member of the Essex Institute, June 4, 1894 and died in Salem, Aug. 13, 1896.

James J. Storrow, son of Charles S. and Lydia (Jackson) Storrow, was born in Boston, July 22, 1837; elected a member of the Essex Institute, Oct. 7, 1895 and died in Washington, D. C., Apr. 15, 1897.

Anna E. Ticknor, daughter of George and Anna (Eliot) Ticknor, was born in Boston, June 1, 1823; elected a member of the Essex Institute, Aug. 5, 1895 and died in Newport, R. I., Oct. 5, 1896.

Francis Tuckerman, son of John F. and Lucy S. (Saltonstall) Tuckerman, was born in Salem, June 11, 1849; elected a member of the Essex Institute, Apr. 30, 1894 and died in Salem, Mar. 31, 1897.

Mrs. Mary A. Turner, daughter of Benjamin P. and Abigail D. (Brown) Kimball, was born in Beverly, May 7, 1828; elected a member of the Essex Institute, May 6, 1895 and died in Marblehead, Jan. 5, 1897.

Charles P. Trumbull, son of George A. and Louisa (Clap) Trumbull, was born in Worcester, Sept. 12, 1830; elected a member of the Essex Institute, Nov. 4, 1895 and died in Beverly, Oct. 8, 1896.

William L. Vinal, son of Moses C. and Sarah (Jenkins) Vinal, was born in New Bedford, Nov. 24, 1854; elected a member of the Essex Institute, Apr. 1, 1895 and died in Boston, Mar. 4, 1897.

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BULLETIN

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JAPANESE COLLEMBOLA.

BY JUSTUS WATSON FOLSOM.

THE few forms with which this paper deals will interest entomologists because nothing has hitherto been recorded concerning the Collembola of Japan. My friend, Dr. Seitaro Goto, was so good as to collect three species for me in Tokyo, which were kindly brought by Professor Mitsukuri, of the Imperial University. Thanks to the care with which the specimens had been killed and preserved, they arrived in excellent condition and, therefore, were not difficult to study. All these species prove to be new and are here named *Achorutes communis*, *Xenylla longicauda* and *Seira japonica*. Many of the types have been deposited in the Museum of Comparative Zoölogy at Cambridge, Mass.

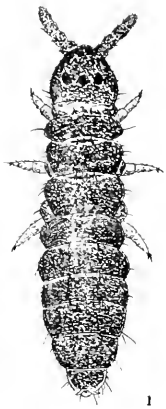
I may take this opportunity to state that *Lepisma* occurs in Tokyo, according to Dr. Goto, and Professor Mitsukuri informs me that *Campodea* is found in Japan, as might be expected.

Family **PODURIDÆ** Tömösvary.

Genus **ACHORUTES** Templeton.

Achorutes communis, n. sp.

General color (Figs. 1 and 2) blackish gray, flecked with pale gray; the sternum, legs, furcula and intersegmental regions are pale gray, which is the real ground color. A dorsal, interocular, black patch is present. Eyes (Fig. 3) eight on either side, situated upon a black patch. Postantennal organs consisting of four elevations (Figs. 3 and 4), which are very variable in form and arrangement; Fig. 4, showing these organs from the right and left sides of the same head, exemplifies this variability. Antennæ subequal to the head, in length, and stout (Fig. 5); segments, in relative lengths, as 6 : 7 : 8 : 10; basal segment compressed longitudinally; second, barrel-shaped; third, swollen apically; terminal segment conical and blunt. Body cylindrical, its segments mostly subequal; between the more anterior segments are transverse, dorsal, lozenge-shaped areas of pale gray (Fig. 1) each containing a narrow, blackish band; blackish dorsal and subdorsal stripes are more or less evident. The head and body are tuberculate, as usual, and are clothed with numerous short, curved bristles, which are sparsely interspersed with longer, stiff setæ. Legs stout, feet biunguiculate (Fig. 6). Superior claw stout, curved, unidentate; inferior claw half as long, with broad base and acuminate apex; a single tenent hair is present. Ventral tube stout, emitting two rounded tubercles. Furcula (Fig. 7) short and stout;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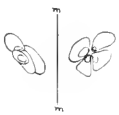
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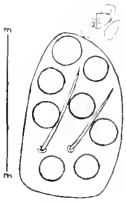
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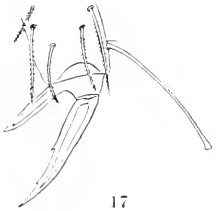
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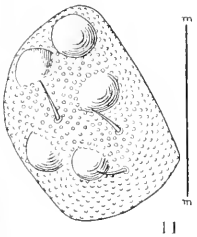
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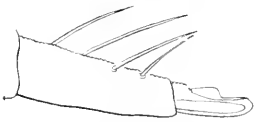
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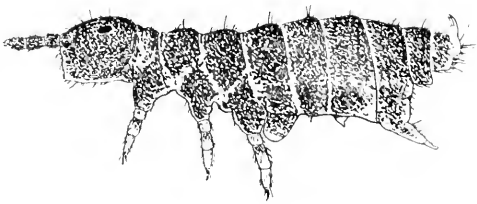
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5

J. W. Fulsom, Del

JAPANESE COLLEMBOLA.

manubrium (basal segment, Fig. 2) swollen; dentes (intermediate segments, Fig. 7) stout, slightly tapering, with stiff bristles; mucrones (apical segments) half as long as the dentes, concave, in form as represented in Figs. 7 and 8. Anal spines (Figs. 1, 2 and 9) two, subequalling the superior claws in length, curving forward and seated upon tuberculate papillæ, the bases of which are contiguous.

Length 1.3 mm. I have examined over three hundred examples of this species, which Dr. Goto found on the surfaces of pools and wells during wet seasons.

A. communis is most nearly allied to *A. armatus* Nic.[1] but I have compared the Japanese form with European examples of *armatus*, which were sent to me by Dr. C. Schäffer, of Hamburg, and find the two forms to be unquestionably distinct. They are separated by considerable differences in form of body, coloration, shape of inferior claws, mucrones and post-antennal organs and arrangement of the eyes.

A. communis also bears much resemblance to *A. longispinus* Tull.[2]

Genus **XENYLLA** Tullberg.

Xenylla longicauda, n. sp.

General color (Fig. 10) dark indigo blue, mottled with yellowish-white, which is the ground color; dorsum with two interrupted black stripes, subdorsal in position; also a black transverse streak in each intersegmental region; sternum yellowish-white, mottled with dark blue. Eyes (Fig. 11) five on either side, hemispherical, seated upon convex, minutely tuberculated, black patches, which are narrowly encircled with white.

[1] Nicolet '41, p. 57, pl. 5, fig. 6; Tullberg '72, p. 51, taf. X, figs. 23–25; Lubbock '73, p. 180–181, pl. 40; Tullberg '76, p. 38, taf. 10, fig. 35; Schäffer '96, p. 173, taf. II, figs. 31, 46 and taf. III, fig. 60.

[2] Tullberg '76, p. 37, taf. X, figs. 31–34; Schäffer '96, p. 191, taf. II, figs. 44, 45.

Postantennal organ absent. Antennæ subequal to the head, in length, with segments in relative lengths as 7 : 8 : 9 : 9; basal segment stout, globose or compressed (Fig. 12); second, swollen apically; third, more slender, cylindrical; terminal segment conical. Body cylindrical-ovate, the abdomen being much dilated laterally; the segments, measured along the median dorsal line, are related in length as 4 : 6 : 6 : 7 : 7 : 6 : 9 : 6 : 3; the head and body are clothed with minute bristles, interspersed with a few longer setæ. Legs stout; tibiæ (Fig. 13) with two, minutely-knobbed, tenent hairs; feet uniunguiculate; claw stout, uniformly tapering, slightly curved and untoothed; inferior claw represented by the merest rudiment. Furcula (Fig. 14) extending considerably beyond the abdomen; manubrium triangular; dentes tapering, each with two setæ; mucrones one-third longer than the dentes, clearly articulated with the latter, very slender, gradually tapering to a minute point. Anal spines and papillæ are quite absent.

Length 1.4 mm. Described from forty-two types, which Dr. Goto found "between the scales of old pine-cones, June 24, 1897."

X. longicauda is decidedly unlike any hitherto described species of Xenylla, but is nearest related to *X. humicola* O. Fabr. (1780, p. 213–214, *Podura humicola*). *X. longicauda*, as contrasted with this near ally, has a furcula which is relatively much longer and much more slender, also mucrones which considerably exceed the dentes in length; moreover there are no traces of anal spines or papillæ, which, although reduced in certain species, nevertheless occur in all other known species of Xenylla.[1]

[1] For descriptions and figures of *X. humicola*, consult O. Fabricius 1780, p. 213–214; Tullberg '76, p. 39, taf. X, figs. 44–46; Reuter '95, p. 32, tab. 2, fig. 10; and Schäffer '96, p. 169–170, taf. 2, fig. 43.

X. longicauda also approaches *X. affinis* Schäffer ('97, p. 10, taf. 1, fig. 17), which differs from both *longicauda* and *humicola* principally by possessing much stouter and unidentate claws, as well as three tenent hairs.

Family **ENTOMOBRYIDÆ** Tömösvary.

Genus **SEIRA** Lubbock.

Seira japonica, n. sp.

Color, ochre yellow, with broad, blackish-purple bands, commonly as represented in Fig. 15; occasionally, every segment of the body possesses a blackish band. Head yellow, bordered anteriorly, and sometimes posteriorly, with black. Eyes normal. Antennæ (Fig. 15) almost half as long as the body, with segments in relative lengths as 7 : 12 : 13 : 14, densely hairy, and yellow with purple apices. Pronotum yellow, frequently marked with black; mesonotum not projecting, yellow, often narrowly bordered with black; metanotum yellow, with an ill-defined band; first abdominal segment usually yellow, but sometimes banded behind, like the remaining segments; each band is generally indistinctly limited anteriorly; second and third abdominal segments mostly black, or else yellow anteriorly; fourth, yellow in front only and with three yellow stripes behind, one being dorsal and two subdorsal in position; fifth, yellow anteriorly; sixth, yellow, sometimes blackish behind. The entire dorsum is abundantly clothed with bowed, clavate hairs, interspersed with short, simple bristles. Scales are present, in addition, which are symmetrical (Fig. 16) elliptical, with a minute rounded pedicel, acute apex and fine longitudinal ribs. Under a one-eighteenth homogeneous immersion objective, the markings are seen to be linear, almost as long as the scale and broadening slightly at their distal portions. Although my specimens were in

alcohol, numerous scales had nevertheless remained attached to the dorsal part of the body which were very constant in size and form. Legs densely bristly, mostly pale yellow; coxæ with a few clavate hairs; femora often purple apically; tibiæ purple basally; hind tibiæ long and slender. Superior claw (Fig. 17) slender, tapering, almost straight, bidentate; inferior claw half as long, broadly linear, acute; tibiæ provided with barbellate bristles and a single, clubbed tenent hair. Furcula half as long as the body, densely covered with clavate hairs proximally and with barbellate bristles distally; segments as 21 : 25 : 2, in relative lengths; dentes (Fig. 18) crenulate, bare distally, and strongly curved (but usually less curved than is represented in Fig. 18); mucrones (Fig. 18) bidentate, as in Entomobrya.

Length, 1.8 mm. Described from nine types, which Dr. Goto found between the scales of old pine cones, under and upon the bark of various kinds of tree, and in the house, occurring during the warmer part of the year.

Seira japonica appears to be nearest allied to a species from Sumatra, *S. annulicornis* Oud., as well as I can judge from the brief description which Oudemans gives ('90, p. 87–88). In his species, however, the terminal antennal segment is much longer, the segments having the ratio 7 : 13 : 12 : 19; the superior claw of *S. annulicornis* is tridendate and the furcula is relatively longer, with its segments related in length as 54 : 54 : 2. In addition, the difference in coloration is decided.

EXPLANATION OF PLATE.

Fig. 1. *Achorutes communis*, n. sp. Dorsal aspect, ×41.
Fig. 2. " " " Left aspect, ×41.
Fig. 3. " " " Eyes and postantennal organ of the right side, ×330 (m–m is parallel with the median line).
Fig. 4. *Achorutes communis*, n. sp. Postantennal organs of the same head, ×330.

Fig. 5. *Achorutes communis*, n. sp. Dorsal aspect of right antenna, × 87.

Fig. 6. *Achorutes communis*, n. sp. Lateral aspect of left hind foot, × 397.

Fig. 7. *Achorutes communis*, n. sp. Mesal aspect of right dens and mucro, × 397.

Fig. 8. *Achorutes communis*, n. sp. Concave surface of right mucro, × 397.

Fig. 9. *Achorutes communis*, n. sp. Lateral aspect of left anal spine, × 397.

Fig. 10. *Xenylla longicauda*, n. sp. Dorsal aspect, × 41.

Fig. 11. " " " Eyes of left side, × 330.

Fig. 12. " " " Dorsal aspect of left antenna, × 87.

Fig. 13. *Xenylla longicauda*, n. sp. Lateral aspect of right fore foot, × 397.

Fig. 14. *Xenylla longicauda*, n. sp. Dorsal aspect of furcula when extended, × 397.

Fig. 15. *Seira japonica*, n. sp. Dorsal aspect, × 21.

Fig. 16. " " " Scale, × 397.

Fig. 17. " " " Mesal aspect of right hind foot, × 397.

Fig. 18. *Seira japonica*, n. sp. Dens and mucro, × 397. (The dens is usually less curved.)

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BIOTITE TINGUAITE DYKE ROCK. CATALOGUE NO. 960.

BY JOHN H. SEARS,

Curator of Geology and Mineralogy, Peabody Academy of Science, Salem, Mass.

OCCURRENCE, ETC.

In the latter part of July, 1896, while investigating the ægirine syenite rocks at Manchester, Massachusetts, I discovered at near low water mark on Gale's rocks, two hundred yards south of Gale's point, a dyke of a very peculiar color, and from a macroscopical examination I decided that it was a new addition to the previously described rocks of Essex County. The dyke is six inches wide and is exposed for twenty feet. It is seen cutting the augite syenite in a nearly horizontal position six feet below the surface of the syenite mass. This outcrop is only exposed at low water as at high water the entire syenite ledge is submerged. The color of this dyke is, on the surface, a grayish green, mottled with bluish-black spots, a freshly broken surface is olive green color and the spots are black. Its occurrence in the immediate region of the ægirine tinguaite dyke at Pickard's point,[1] "analcite tinguaite," Dr. Henry S. Washington,[2] and of the ægirine

[1] J. H. Sears, Bulletin Essex Institute, Vol. XXV, 4, 1893.

[2] H. S. Washington, American Journal of Science, Vol. VI, pp. 182–187, 1898.

DYKE OF BIOTITE TINGUAITE, IN AUGITE SYENITE LEDGE, MANCHESTER, MASS

syenite at Gale's point, gave this rock a special interest to me, and I collected several specimens of it as addition to the collection of the rocks of Essex County, in the cabinets of the museum of the Peabody Academy of Science and for special study. In October, 1896, I prepared six thin sections of this rock for microscopical examination, and from these sections I determined the following minerals in its composition: ægirine, nepheline, sodalite, biotite, a triclinic feldspar, microperthite, and some larger feldspars that gave optical characters which led me to consider them anorthoclase, as they had nearly the same structure as the anorthoclase phenocrysts in the keratophyre rock from Marblehead harbor.[1] The black spots in the rock were magnetic iron, a decomposition product of an original biotite. The ground mass was so associated with fragments and grains of ægirine, and microliths of feldspars, that it was deemed necessary to have a chemical analysis made of the rock before determining it. In May, 1897, I showed the specimens and thin sections of this rock to Dr. J. E. Wolff at Harvard University, and told him my conclusions as to what it was; subsequently the specimens and sections of this dyke rock were placed in the hands of Dr. Arthur S. Eakle of the Petrographical Laboratory at Harvard University to investigate and analyze.

Dr. Eakle has worked out a very careful and minute microscopical and chemical analysis of this interesting dyke rock which is as follows:—

Macroscopically the rock has a compact holo-crystalline structure, breaking with an even fracture; and a greenish gray color with a slightly greasy luster, like rock rich in nepheline. Small phenocrysts of feldspar are scattered throughout and also much magnetite in patches which latter give a mottled appearance to the rock.

[1] J. H. Sears, Bull. Mus. Comp. Zoology. Geographical series, Vol. No. 9, 1890.

Under the microscope the rock is seen to be composed mainly of feldspathic laths and plates with much nepheline and less amounts of ægirine, magnetite and biotite. A little sodalite, apatite and zircon are also present.

The feldspar forms the principal constituent and predominates in lath-shaped sections, which have a ragged appearance, due to frayed-out ends and a fibrous structure. This fibrous appearance is caused by lamellar intergrowths of the soda and potash feldspars, microcline and albite, forming microline-microperthite. Some of the broader sections show a rather coarse intergrowth of the two feldspars giving extinctions on different parts of the same section, corresponding respectively to these two feldspars, while some which do not show the perthitic structure may be anorthoclase. Carlsbad twinning of the laths is common. Besides the lathshaped sections, many plates occur, which are cleavage sections parallel to M, of albite. They show basal and prismatic cleavage cracks, an optic axis and extinguish at 20°.

The nepheline occurs next to the feldspars in amount, and occupies the position of a filling matter in the interspaces formed by the feldspars. It has been the last mineral to form and most of it is in xenomorphic angular sections, but here and there, well defined hexagonal plates are seen. The nepheline has altered and is present as grayish, muddy, granulated sections which are apparently mixtures of nepheline with kaolin and very fine grains of quartz; the alteration being to a hydrous aluminium silicate through loss of alkalies, rather than to a zeolite. The sections still retain their index above that of the feldspars and gelatinize with HCl as shown by fuchsin staining, yet this reaction was not so well and easily obtained as with fresh nepheline.

Ægirine is disseminated in the rock in fragments and

small crystals, in sufficient amount to give the rock its greenish cast. Its crystallization preceded that of the feldspars and the crystals are rounded or broken, irregular fragments. The sections occur from deep grass green to almost colorless, and the deeper colored show a marked pleochroism a = bluish green, b = grass green, c = greenish-yellow. The axis of greatest elasticity lies nearest to c and the extinction in most of the sections is practically parallel.

Magnetite is prominent and marks the remains of rather large plates of a former dark silicate. Most of the original silicate has completely disappeared, leaving only the patches of black oxide of iron, but in an occasional section, a greenish-brown silicate still remains between the black borders of magnetite, which from its absorption, parallel extinction and characteristic shimmer, is evidently biotite. From the similarity of the sections, it is reasonable to assume that they were all originally this biotite, and if so it must have been a biotite very poor in magnesia, since so little of this oxide occurs in the rock.

Sodalite is seen in small purplish to colorless isotropic sections of low refraction, some showing dodecahedral cleavage lines. A few small crystals of apatite and zircon occur as inclusions in the feldspars.

The tinguaite dike at Pickard's Point, Manchester, originally described by Sears,[1] has been shown by Washington[2] to contain much analcite and he classifies the tinguaites of this locality as analcite tinguaites. Very little isotropic mineral occurs in the dike described here and from its appearance and the presence of chlorine what is present is judged to be sodalite, so the dike can hardly be classed with the one he describes.

[1] J. H. Sears, Bull. Essex Inst. XXV, 4, 1893.
[2] H. S. Washington, Am. Jour. Sci. VI, 1898, p. 176.

The structure of the rock also differs from that of the Pickard's Point dike, which has the typical tinguaitic structure, in that the component minerals do not occur in needle forms, but in much stouter lath-shapes, showing a greater degree of crystallization for the individual minerals, and producing a much less dense phase of tinguaite. The presence of many plates of feldspar tabular to M indicates an approach to a sölvsbergite, and the rock might perhaps with equal right be considered a phase of a nepheline sölvsbergite. It seems in structure and composition to lie intermediate between a nepheline tinguaite and a nepheline-ægirine-sölvsbergite.

The analysis of the rock yields

SiO_2	60.05
Ti O_2 and ZrO_2	0.11
Al_2O_3	19.97
Fe_2O_3	4.32
Fe O	1.04
Mn O	0.79
Ca O	0.91
Mg O	0.23
K_2 O	3.24
Na_2O	7.69
H_2O at 110	0.15
H_2O ig.	1.26
Cl	0.28
	100.04

The specific gravity determined by the balance is 2.708. The dike is difficult to reach and the specimens examined come from near the surface and have altered enough to make it difficult to estimate the mineral contents with any degree of accuracy. It is at once apparent that the percentage of alkalies is too low to use up

all of the silica and alumina in the formation of the alkali minerals, and the excess of these two oxides must evidently combine with the water to form kaolin, leaving besides a small excess of free silica, which is seen in the slide as a separation product from the alteration of the nepheline. Fully twenty per cent of the slide appears to be nepheline, yet the soda will only allow for about one-half of this amount, and fourteen per cent only of the rock is soluble in HCl. A calculation from the percentage composition, with due regard to the microscopic estimation, gives the following as the approximate mineral composition:

47.16 $Na_2 Al_2 Si_6 O_{16}$	
16.68 $K_2Al_2 Si_6 O_{16}$	67.28 % feldspar.
3.44 $CaAl_2 Si_2 O_8$	
9.61 $Na_6 K_2 Al_8 Si_9O_{34}$	
8.09 $H_4 Al_2 Si_2 O_9$	20.32 % nepheline, kaolin and quartz.
2.62 SiO_2	
6.00 $Na_2 Fe_2 Si_4 O_{12}$ =	6.00 % ægirine.
2.90 Biotite.	
3.50 $Fe_2 O_3$ (Fe Mn) O	6.40 % biotite and magnetite.
100.00	100.00

PLATE.

Biotite tinguaite dyke cutting augite syenite.

The dyke may be detected near the bottom of the ledge by my note book at near one end and on the other by a Boston and Maine railroad time table placed in the contact walls where the dyke has been eroded out.

SALEM, AUG. 21, 1898.

BATTLES OF THE BLACK ANTS.

BY REV. W. P. ALCOTT.

THE wood borings of *Formica Pennsylvanica* L. are often wonderful. Sometimes these insects will form, in a soft pine log, a maze of halls, chambers, corridors, and spiral passages, separated by walls little thicker than paper, and altogether of great architectural beauty and finish.

But attention is now to be called to another line of activity conspicuous in these insects. If investigation of their singular conflicts has been made, it has not happened to attract my notice. The following observations are recorded that they may incite some young Lubbock or McCook to find the cause and purpose of these wars.

On the morning of June 26, 1883, I observed numbers of large black ants wandering excitedly over a back piazza of my house in Boxford, Mass. More careful observation showed a dozen of their dead bodies scattered around, while two living insects were struggling in a desperate conflict. In some places dissevered legs and antennæ were thickly strewn, while in retired nooks living ants were resting, either exhausted, wounded or skulking. I gathered over twenty corpses from the piazza and the ground. Some of these warriors, having mutually in-

flicted mortal wounds, had never relaxed their iron embrace but lay dead in pairs.

The conflict was not yet ended and I watched one of these Homeric encounters. An ant had his antagonist's feeler in his jaws. The combatant, thus held, twisted and turned to get his own mandibles upon feeler, leg, neck or waist of his antagonist. He was, evidently, much unnerved by the other's hold, for these antennæ seem as sensitive as the eyeball, and he was dragged about, resisting and struggling in every way, but all in vain. Finally, the antenna came off near the base and the two warriors parted.

Single combats like this probably went on through the day and a few occurred the following night, for in the morning I found more dead bodies. One wounded soldier died in my custody and many doubtless in cracks and nooks, but the level floor seemed to be the main battlefield. Altogether I collected from the fight about seventy complete bodies or dissevered heads which I preserved in a red pill box—the rather gaudy tumulus of this Waterloo!

In the same place on the morning of July 7, following, I found traces of another battle which was not yet finished. Again, July 19, there had been a battle during the night on the bare floor of a chamber at the opposite end of the house and upstairs. One morning in August, of the same year, I found traces of a similar battle in the cellarway of a neighboring house.

Recurring to the conflict of July 7, I may give from notes made at the time, a more particular description. The ants engaged were evidently workers of the two kinds, having either large heads or small ones — megacephalic or microcephalic. I observed especially a struggle between one of each kind whom I may call for brevity, Meg and Mic, or Mike, abbreviations of the above tech-

nical words. The latter was then alone, all the others being large-headed and seemingly bent on his destruction. But Mike was undaunted and full of fight in spite of being alone among numerous big-headed foes. Indeed, the latter seemed generally afraid to get too near him. At length one of them ventured to clasp jaws, which seems to be the "first hold." Then the two began to bend their tails as if to sting or to inject poison into one another's mouth, an issue which each endeavored to prevent. Other ants attacked Mike, pulling upon his legs and attempting to fasten upon the connection of his abdomen. Meg dragged Mike about, both at times apparently attempting to sting. Mike was dying in half an hour, probably from exhaustion or poison.

Later two dropped from overhead in energetic and deadly conflict — not ceasing under my capture and observation of them. These also were a Meg and a Mike. The former, as before, was stronger, the latter more active and ferocious. He had Meg by an antenna, but Meg pulled him around, Mike keeping his abdomen so curled as to prevent his antagonist's jaws from a fatal grip on his slender waist. Mike had already lost half of one foreleg and all of a middle one. Meg was minus one entire front leg and was lame in a leg of the next pair, but he was biting vigorously, though in vain, at Mike's hard and polished abdomen. At last Meg's feeler parts where the other has hold and Mike clutches the tip of the remaining feeler. This quickly gives way and he seizes the base, while a small colorless drop exudes from the broken end. Now this antenna parts at the base and, after having fought twenty minutes under my eye and perhaps previously much longer, they separate, the advantage being with Mike. Though confined together, they did not care to fight again. One died during the following night and the other

several days later, perhaps from some abnormal condition of his confinement. Unfortunately, I did not note which died the sooner, but probably it was Meg, who was more injured.

Often since the above observations, I have noticed, about another residence, the corpses left by similar encounters of these ants but I have discovered no additional facts. No similar battles of our other Massachusetts species have ever come under my observation.

Some twelve or fifteen years ago an anonymous correspondent of the St. Louis Republican described a battle of ants in southwestern Missouri. Evidently these were our "black ants." The account tallies so exactly with what I have seen in our own county, that I quote it entire, as follows:

"I am a pedagogue in the rural districts of Newton County, Missouri, and my schoolhouse had been infested for several months by a species of a large black ant, much to the annoyance of the little barefooted scholars, and there seemed to be no way of getting rid of the pest. But what was my astonishment a few mornings since on coming into my school-house, to find the floor literally strewn with dead and dying ants, and upon a closer examination to find that a desperate battle was then raging among them more sanguinary and fatal than any I ever witnessed (and I saw many a hard-fought battle during the late unpleasantness) or read of [in the annals of history]. A much larger number were lying dead than were left engaged, and I therefore concluded the battle had raged all night. Most of the combatants engaged were grappled in a deadly embrace, while others but recently commenced were standing erect on their hind legs, and soaring for the advantage with all the science of the most experienced swordsmen or pugilists. The most fatal point of attack,

and the one for which it seemed all contended, was the ligament which joined the main body with the head. This vital member once seized by the powerful nippers, death succeeded without a struggle, and the victor was ready and eager for another engagement.

No undue advantage was taken by either party; and no two would endeavor to overpower a single one; nor was there any flinching or wavering in a single instance, for whenever two belligerents met it was certain death to one or both parties. Never, perhaps, were two armies more equally matched in numbers, strength and valor; and consequently at the close of the battle, which lasted two nights and a day, as new recruits continued to arrive at every moment, there were but few left, and probably none of the vanquished army, thus rivalling the valor of the heroes of the Alamo and the Spartan band of Leonidas. Observing closely, I could see a slight difference in the appearance of the contestants, one set being perfectly black, with a large head, while the other was nearer brown, with a smaller head, though both about equally matched in size and strength. Dismembered legs were numerous, and many an unfortunate though valiant hero, being entirely deprived of his supporters, was thus left, *hors de combat*, to die on the field. The next morning I swept up the dead and dying of both armies (for I would not disturb them while engaged), amounting to thousands."

In view of the facts given, my own suggestions are now added. That the maiming alone does not always cause the death of these ants is evident. Unless I am greatly in error, experimenters have proved this by clipping off antennæ or legs. Death does not follow for several days at least, and then perhaps from inability to obtain food or drink. Indeed, I observed an ant running about for a long time with his abdomen bitten off or hanging only by

a filament drawn out so that his stomach was upon his shoulders — where perhaps some of us ought to have it! For all this, the ant was very lively and did not appear to suffer. Again combatants will sometimes die in a few minutes with no wound that a microscope can discover.

It is possible that death is caused by the injection of formic acid, saliva or some other natural secretion into the wounds or mouth. It is admitted, I believe, that animal products take on specially poisonous properties under the influence of rage.

It was astonishing to note the desperation of the encounters. Sometimes others interfere in these dual conflicts as in one case cited above, though this appears exceptional. When two ants grapple it means the death of one or both. Many pairs were found locked in an embrace mutually fatal. Others are seen running around with the dissevered head of an antagonist locked in its final grip upon an antenna or leg. Such a warrior would not loosen his hold though his enemy or some comrade should succeed in his decapitation. The trophy may be "glorious," but it is quite an incumbrance and the bearer tries in vain to secure relief from his ornament.

As to the cause of these battles, I can make no conclusive suggestion. It is, of course, not to be supposed that the insects of the formicary have discovered, as man has, that by such sanguinary conflicts, great questions of ethics and property rights may be settled with infallible exactness!

There is said to be great diversity in the social economy of different species of Formica. With some kinds there are battles between rival nests, but I could discover no evidence of this in the cases mentioned. From the impossibility of finding the houses of these wood-borers, my opinion may not be correct. But the slow accumulation of the slain and the insignificance of the numbers at any

one time seen in conflict suggested some other cause than hostile colonies, or a struggle for booty.

Contrary to the Missouri testimony, my pill-box mausoleum shows that the struggles were *not* uniformly between the large-headed and the small-headed ants. Often two of the former or two of the latter are locked in the final clasp. I could discover no rule of difference in size or color.

All these conflicts, I believe, began in the night — usually, if not always, on sultry nights. There may be a kind of craziness, a propensity to "run amuck," which at times seizes a part or all of the workers of a formicary. Some ants were generally recognized as friends, some as enemies. Is it a witchcraft delusion?

My present residence was built in 1770 and early in summer is seriously infested with these insects. Later they are rarely seen in the house. Is it possible that these battles are due to some Malthusian instinct by which, when their services are no longer needed, the great mass of the soldier and worker class slay one another and thus empty the formicary that there may be room and welcome for another generation? Or is there a survival, in this way, of the young and vigorous? Some of the questions suggested can be finally answered only by the carefully recorded observations of many independent and skilful students of nature.

SOME GLACIAL WASH-PLAINS OF SOUTHERN NEW ENGLAND.[1]

BY J. B. WOODWORTH.

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[1] Published by permission of the Director of the U. S. Geological Survey.

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INTRODUCTION.

The glacial wash-plains or stream deltas and fans of southern New England constitute by far the most important feature in the pleistocene deposits of the area, for the reason that they cover the larger part of the lowlands; on these flat spaces the greater number of towns and villages are built; the sands and gravels determine the nature of most of the problems of local water-supply and drainage; and because of their scientific bearings in determining the history of the glacial retreat across this portion of our country, as well as in the evidence they are thought to afford concerning the attitude of the land and sea at the close of the Glacial Period. The notes which are here brought together present but a crude outline of the results which may yet be gained in this field by a careful mapping and investigation of these old glacial stream deltas. These glacial deposits remain almost as sharply defined as when abandoned by the ice. The growth of forests and the development of swamps in the low wet grounds alone offer difficulties to the rapid and satisfactory interpretation of the glacial history of the district.

The writer has had the opportunity of examining those portions of this area which lie within the geologic field known as the Narragansett Basin of Carboniferous rocks and the islands off the south coast. Some of the leading facts concerning wash-plains occurring about Narragansett Bay have already been published as noted in the annexed references to the literature.

BIBLIOGRAPHY.

The following references include those papers which relate to the country lying south of a line drawn from Boston to Worcester and east of Connecticut. A few papers relating to the New Haven region are added.

1856. Prof. Edward Hitchcock,[1] in describing the surface geology of New England, refers to gravelly and sandy plains of the lowlands as "sea-bottoms."

1879. Mr. Warren Upham,[2] in a paper on "The formation of Cape Cod," discusses the leading facts in the moraine of that stage.

1880. The same author[3] later discusses "The succession of glacial deposits in New England."

1881. Mr. Upham[4] describes "The Glacial Drift in Boston and Vicinity."

1883–84. The late Professor J. D. Dana, in a paper under the title of "Phenomena of the glacial and Champlain Periods about the mouth of the Connecticut Valley, in the New Haven region,"[5] gives a detailed map of the glacial sand-plain about New Haven with elevations and discusses the origin of the plain and its features. He refers the deposit to coalescing sand-bars formed by flooded waters in the valley during the retreat of the ice-sheet. Deep depressions in the plain are ascribed to lack of deposition. It was held that the ice had vanished from the district when the plain was deposited.

1888. Professor Shaler[6] made a report on the Geology of the Island of Martha's Vineyard, in which he describes the large outwash plain or frontal apron, ascribing it to

[1] Illustrations of Surface Geology, 1856, p. 44.
[2] Am. Nat. vol. XIII, 1879, pp. 489–502; 552–565.
[3] Am. Assoc. Adv. Sci. Proc. vol. XXVIII, pp. 299–310.
[4] Proc. Boston Soc. Nat. Hist. vol. XX, pp. 220–234
[5] Am. Journ. of Science, vol. XXVI, 1883, pp. 341–361; and vol. XXVII, pp. 113–130.
[6] 7th Annual Report, U. S. Geol. Survey, pp. 314–320.

deposition from subglacial streams discharging their load of sand and gravel below sea-level. The creases are explained as due to initial shaping by the outrunning streams and to subsequent modification by the to-and-fro movement of tides. The depth of water, not definitely determined, is thought to have been as great as 300 feet.

1889. Professor Shaler,[1] in this year, published a report on the Geology of Nantucket, in which he describes the outwash plain of that island, notes its surface features, including the creases, and discusses the relations of the head of the plain or terrace to the currents which deposited the detritus in the plain.

1890. Professor Davis,[2] in a paper "On the Structure and Origin of Glacial Sand-plains," gives a critical study of an esker-fan near Newtonville, Mass.

1891. Mr. Upham,[3] in a paper entitled "Walden, Cochituate and other lakes, enclosed by modified drift," describes certain ice-block holes in this area.

1892. Professor Davis,[4] in a paper "On the Subglacial Origin of certain Eskers," considers sand-plateaus as deltas marginal to the ice-sheet.

1893. Professor Davis,[5] in a publication entitled "Geographical Illustrations," notes the occurrence and influence of numerous sand-plains on settlement in this district.

1893. Dr. F. P. Gulliver[6] describes a model based upon the esker-fan at Newtonville previously described by Professor Davis. A second model is introduced to show supposed relations of the ice-front to the delta.

[1] Bulletin 53, U. S. Geol. Survey.

[2] Bull. Geol. Soc. Amer., vol. 1, pp. 195-202, pl. 3.

[3] Proc. Boston Soc. Nat. Hist. vol. xxv, pp. 228-242.

[4] Proc. Boston Soc. Nat. Hist. vol. xxv, 1892, pp. 477-499.

[5] Geographical Publications. Published by Harvard University, Cambridge, Mass., 1893, pp. 46. Reprinted from the Proceedings of the Am. Institute of Instruction, 1892.

[6] The [Chicago] Journal of Geology, vol. 1, 1893, pp. 803-812.

1893. J. B. Woodworth,[1] in a paper entitled "An attempt to estimate the thickness of the ice-blocks which gave rise to lakelets and kettle-holes," mentions several glacial lakelets in the sand-plains of this district, and discusses the bearing of outlet creases to marine submergence.

1896. J. B. Woodworth[2] describes "The Retreat of the Ice-sheet in the Narragansett Bay region," enumerating several successive lines of sand-plains in southeastern Massachusetts and Rhode Island.

1896. In a later note[3] the last author gives reasons for thinking that certain sand-plains in the Narragansett Bay region were deposited above sea-level.

1896. Prof. W. O. Crosby and Mr. A. W. Graban[4] refer certain wash-plains in Hingham and Weymouth to deposition in a lake held up by the retreating ice front.

1896. Messrs. Shaler, Woodworth and Marbut, in a paper on "The Glacial Brick-clays of Rhode Island and southeastern Massachusetts," describe some of the wash-plains and attendant clay deposits of this area.[5]

1898. Mr. M. L. Fuller[6] writes on "The Champlain Submergence in the Narragansett Bay Region," and attempts to show that wash-plains in that area were deposited at sea-level.

1898. Professor Shaler,[7] in a paper on the "Geology of the Cape Cod District," describes the moraines and underlying deposits.

1899. J. B. Woodworth[8] publishes "The ice-contact

[1] Am. Geol. vol. XII, 1893, pp. 279-284.
[2] Am. Geol. vol. XVIII, 1896, pp. 150-168.
[3] Am. Geol. vol. XVIII, 1896, pp. 391-392.
[4] Abstract in Science III, 1896, pp. 212-213.
[5] 17th Annual Report, U. S. Geol. Survey, pt. I, 1896, pp. 951-1004.
[6] Am. Geol. vol. XXII, 1898, pp. 310-321.
[7] 18th Annual Report, U. S. Geol. Survey, 1898, pt. II, pp. 497-593.
[8] Am. Geol. vol. XXII, 1899, pp. 80-86.

in the classification of glacial deposits," based upon a study of the glacial deposits in this field.

THE WASH-PLAINS OF EXISTING GLACIERS.

Existing glaciers present two general types of wash plains which may be briefly described as follows. First, in the case of valley glaciers, where the ice front commonly rests upon a slope high above base-level, the gravel and sand washed out from the ice accumulate in a sheet or fan below the base of the ice. Such is the case with the debris washed out from the glaciers of Chamonix in France. It is a characteristic of glaciation in a mountainous or upland region.

Where the ice spreads out on the lowland, we have the second case, in which, owing to delta building in lakes or the sea or upon a plain, the wash accumulates in front of the ice as a fan of gentle slope banking up against the ice margin.

Probably in all cases where the term plain is used, the form is that of a fan or a group of fans; and from these almost level-topped deltas to steeper sloping deposits and to cones there is a gradual passage. The term *plains* is thus only roughly correct when applied to the group of deltas which have accumulated at the ice-front.

This second group of deposits is found to-day in process of formation only in high latitudes. Examples are here cited for comparison with New England cases.

The Heard Island wash-plain.— A graphic account of an outwash plain now in process of formation is given by the late Canon Moseley in his description of Heard Island at the time of the visit by the Challenger. Heard Island lies in about lat. 53° 10′ S., and long. 73° 31′ E. The following is abstracted from Moseley's account:[1]

[1] Notes by a Naturalist, made during the Voyage of the Challenger. Revised ed., New York and London, 1892, pp. 191-192.

"The view along the shore of the successive terminations of the glacier was very fine. I had never before seen a coast-line composed of cliffs and headlands of ice. The bases of their cliffs rested on the sandy beach and were only just washed by the waves at high water or during gales of wind. The lateral moraines were of the usual form, with sharp ridged crests and natural slopes on either side. They formed lines of separation between the contiguous glaciers. They were somewhat serpentine in course, and two of them were seen to occur immediately above points where the glaciers were separated by masses of rock *in situ*, which masses showed out between the ice cliffs on the shore and had the end of the moraines resting on them.

"A stretch of perfectly level black sand about half a mile in width forms the head of the bay and intervenes between the glaciers and a promontory of rocky rising land stretching out northwards and westwards, and forming the other side of the bay. It was on the smooth sandy beach bounding this plain that we landed. The surf was not heavy, but we had to drag the boat up at once . . . The sandy plain stretches back from the bay as a dreary waste to another curved beach at the head of another inlet of the sea. Behind this inlet is an irregular rocky mountain mass forming the end of the island, on which are two large glaciers very steeply inclined, and one of them terminating in a sheer ice-fall . . . The plain is traversed by several streams of glacier water coming from the southern glaciers. These streams are constantly changing their course as the beach and plain are washed about by the surf in heavy weather. At the time of our visit, the main stream stretched across the entire width of the plain and entered the sea at the extreme western verge of the beach. We therefore had to ford it.

"The stream was about twenty yards across and knee deep. It was intensely cold, and pained my legs worse than any glacier water I have ever waded in. The water of the stream was brown, opaque and muddy, charged with the grindings of the glaciers. Running into the sea it formed a conspicuous brown tract, sharply defined from the blue-green water of the sea, and extending almost to the mouth of the bay. The sandy plain seemed entirely of glacial origin; it was in places covered with glacial mud, and was yielding and heavy to walk upon.

"Mr. Buchanan observed that the isolated rocks which had been rolled down upon the plain from the heights above were cut by the natural sandblast into forms resembling trees on a coast exposed to trade winds. The effect of every prevalent wind was shown by the facets cut by the blown sand upon the surfaces of the rocks, the largest facet in each case being that turned towards the west."

Alaskan wash-plains.—Professor Russell[1] has described several examples in the glacial region of Mt. St. Elias, Alaska, analogous to that of the Heard Island plain. True alluvial cones also form in this region along the steep ice margin where the drainage escapes from tunnels in the ice.

GENERAL CHARACTERS OF EXTRAGLACIAL WASH.

From the foregoing bibliographic references it will be seen that several writers have described forms composed of glacial sand and gravel accumulated at the front of the ice-sheet in the manner of deltas and alluvial fans. These deposits have a definite, recognizable form and structure, and have for some time taken rank with moraines, drum-

[1] I. C. Russell. The Glaciers of North America, Boston, 1897. See also papers by same author in National Geographic Magazine, iii, 1890, pp. 51-203, and 13th Annual Rept. U. S. Geol. Survey, pt. II, 1891, pp. 1-91.

lins, eskers, kames and terraces, in the classification of glacial deposits.

So far as glacial drainage repeats the conditions existing in ordinary streams and rivers, we should expect to find, at the mouths of rivers and streams discharging from the ice, alluvial deposits corresponding in all essential respects to deltas with lobate and multilobate margins, to alluvial cones and fans, and to confluent cones and fans. The examination of the region here described has revealed examples analogous to most of these types, differing only in the respect that the deposits were built against or in the presence of an ice formation instead of a rock formation and that, by the melting of the ice, anomalies in the topography have been introduced which separate the group, often widely, from those deposits of non-glacial origin.

FIG. 1. Contour map of the Saylesville esker-fan (area left white) in Rhode Island. Horizontally ruled areas, swamps; black areas, ponds; dotted areas marginal terraces of sand and gravel. (Topography from Providence atlas sheet, U. S. Geological Survey.)

The following classes of glacial stream deposits are here recognized under the head of extraglacial wash:

Wash-plains, comprising gently sloping areas of gravel and sand deposited along the ice front. They are divisible into kinds dependent on their relations to frontal moraines, the ice-margin, and to the ice-margin and eskers.

From their relations to frontal moraines there arise overwash-plains banked up against the outer edge of the frontal moraine.

From their relation to the ice-margin alone there arise:

a. Frontal moraine terraces, with an ice-contact slope, charged with till and boulders, a true morainal deposit.

b. Frontal terraces, like the preceding but lacking the till-coating along the ice contact.

c. Esker-fans, small plains of gravel and sand built at the mouth of subglacial tunnels and channels in the ice; associated with an esker or esker-like chain of deposits made in the ice-sheet at the same time — *e. g.*, Newtonville, Mass.; Saylesville, R. I.

d. Wash-cones, steeply sloping deposits, with ice-contact slope on the iceward side culminating in a high point, with gentler slope outward, in the manner of alluvial cones — *e. g.*, Sprague Hill, Bridgewater; the deposit south of Waban Station, Mass.; deposits near Davisville, R. I.

With these general types are associated minor topographic features due to the mode of origin of the deposits or inherent in their relations to preëxisting formations. Some of these features are here described:

Drainage creases.— The largest plains of the outermost moraine in this area bear strongly defined drainage furrows, thought by all to mark the paths of streams flowing out from the ice-front at the time it lay along the head of the plains. By analogy with the channels on existing plains of like origin we should infer that these streams flowed in the open air.

These creases may traverse the entire breadth of the plain from the ice-contact to the distal margin. Many furrows are traceable only on the lower, outer margin of the plain for the reason that the later deposition of gravel in the form of fans along the ice-front clogged up and effaced the upper portions of such furrows.

During the construction of a delta in a water basin with constant level, the delta margin grows forward with the discharging streams running on the lobate axis. If the water level suddenly fall off, we should expect a stream to become diverted to the furrow between two lobes. To what extent the lobate aspect of some of the large creased

plains is really of constructive origin and to what extent purely erosional has not been definitely determined.

The study of creased plains becomes important in determining change of water level during the duration of the ice mass at the head of the plain, as in the case of the Barrington esker-fan in Rhode Island, where the writer has attempted to demonstrate that the water-level fell off from forty to fifty feet after the construction of the delta and before the disappearance of the ice at its northern margin.

Boulder-paved creases.— In those areas in which the outwash of gravels took place on lower ground than that on which the ice front rested, a case which occurs in the Mansfield region and eastward towards Brockton, there are occasionally exhibited north and south troughs, on till areas, marking the outflow of water from the ice. Such creases are usually paved with boulders and so resemble torrent beds although the inclination of the crease may be gentle. Such boulder-lines, although the material is identical with that of the boulder belts, should be classed with the water-laid drift deposits. One or two lines of these stream beds occur near North Easton on the northern border of the Narragansett Carboniferous area.

Kettle-holes, ice-block holes.— Many wash-plains are interrupted by depressions. Crateriform hollows probably indicate the site of buried masses of ice which on melting out allowed the gravel cover to settle. A cross-section of the wash-plain should here exhibit a quaquaversal synclinal. Crosby has observed sections of this character near Boston. It would be an advantage to restrict the term kettle-hole to depressions of this class.

Many depressions have steep sides, with coarse detritus, like the ice-contact phase of wash-plains in which they lie. These depressions are usually much larger than

kettle-holes and frequently are the sites of large glacial lakes. Depressions of this class are typical ice-block holes.

A drainage crease sometimes starts from the ice-block hole and traverses the plain; such furrows do not originate in kettle-holes as defined in this paper. In the kettle-hole the ice did not rise above plain level; in the ice-block hole, the ice once rose above plain level and the drainage ran across the plain.

Imperfect ice-block holes sometimes occur in the margin of wash-plains as between the lobes of the Drownville delta in Rhode Island. A similar phenomenon has been reported by Fairchild in western New York.

Large ice-block holes surrounded by the ice-contact are to be distinguished from "unfilled areas" between successive retreatal plains. Such unfilled areas will exhibit the ice-contact about their southern margins and lobate delta fronts about their northern border where later plain building has carried sands into the depression.

From the point of view of glacial geology, the occurrence of lakes in ice-block holes is an accident dependent on the height of the water-plane in the surrounding gravels. There are many ice-block holes of large size without lakes. Such depressions exist in the Plymouth area.

Ice-block holes are sometimes grouped, as where in the bottom of a large depression there are two or three isolated deep holes. The accompanying map (fig. 2) of the Agawam river area in Plymouth County, Mass., shows an example of this mode of occurrence. In this case the holes are occupied by water.

Typical ice-block holes in this region seldom, if ever, show ravines caused by streams eating back into the surrounding terrace. Kettle-holes, on the contrary, as in

the Robin Hill district, near Providence, R. I., not infrequently show wet weather gullies on the convex brow of the slopes, with alluvial fans converging in the bottom of the pit. These gullies have the appearance of recent origin. I owe the suggestion to Prof. George F. Wright that a very recent melting out of buried ice might give rise to changes now going on in the drainage of areas occupied by kame kettles. A kame-kettle recently formed would for some time be subject to marginal gullying. The observed results meet the expectations from theory; but the duration of the postglacial epoch has been so long that one's judgment, perhaps wrongly, rejects the conclusion that buried glacial ice still lingers in this field.[1]

FIG. 2. Ice-block holes near Agawam River, giving rise to three lakelets in a larger depression. (From Plymouth atlas sheet, U. S. Geological Survey, topography by Grambs, Smyth and Thompson.)

Inliers of older drift.— The contour of the wash-plains is frequently broken by knobs of coarse gravels or by till knolls and small drumlins. Both kames and eskers may be partly buried under the growing edge and rising level of the wash-plain. These features of deposition are illustrated in the area on the west of the Boston & Albany Circuit Railroad between Woodland and Waban stations. The Newtonville esker-fan encloses older knobs of drift.

Irregularities in texture and structure of plains may be largely explained as the result of the burial of drift deposits previously laid down. These abnormal textures are invariably coarser than the detritus in the body of the plain.

[1]See the literature concerning the ice wells in Vermont. Report of the committee appointed to examine the frozen well at Brandon, Vt. Proc. Boston Soc. Nat. Hist. viii, 1862, pp. 72-88.

Loess-like cover.— The sand-plains as well as the till of New England frequently bear a capping of fine loamy sand of loess-like consistency and further resembling loess in that the material is devoid of stratification; it stands up a long time in steep cuts, and appears to owe its origin to the blowing of dust in the post-glacial epoch. In places, the material appears to be in process of accumulation by depositing between the grasses so that the sod grows upward according to the rate of accumulation of dust. The underlying subsoil exhibits traces of decayed plants in roots and occasional branches which have been buried in the development of the deposit. This loess-like cover is conspicuous in low places in the sand-plains where it constitutes a sheet from a few inches to two or three feet in thickness. It may frequently be found at the foot of hills on terraces or plains. Deposits of this loess, on the southern part of Prudence Island, are from three to four feet thick where not recently removed by the winds.

This loess-like cover has much to do with producing the level of some of the wash-plains as it has also with the smooth flowing contours of the knob and basin type of drift deposits. It is largely, I believe, the product of post-glacial eolian action and this view finds support in the common occurrence of sand-blasted pebbles on the surface of wash-plains in close connection with the loess-like cover.

The deflation of the wash-plains does not usually result in the formation of dunes. The sands which are coarse shift somewhat to and fro with the stronger winds, but the prevailing direction of transportation is eastward, at least near Boston, for the reason that the easterly winds strong enough to move the finer sands are usually so damp as to cause the sands to cohere by reason of the films of water which coat the grains. The dry westerly winds alone effect the removal of dust.

Sandblasting and glyptoliths.[1]— The pebbles on the surface of the wash-plains frequently exhibit the touch of the natural sandblast. Sharply carved glyptoliths have been noted in many localities. The widespread occurrence of these pebbles beneath the soil in New England, in areas where the wind is not now blowing sand, makes it highly probable that immediately after the ice retreated and before vegetation came in, the barren sandy stretches were for a time in a desert condition.

Superposition of plains by raised water level.— Plains may exhibit the phenomenon of superposition in which the outward margin in the case of partial overlap assumes the form of grouped terraces, the lobate margin of the first formed plain extending beyond the lobate margin of the overplaced plain. This phenomenon is due to a rise of the water level above the surface of the first plain so that construction begins anew at the ice contact. It is shown in the superposition of a small plain on those which encircle Greenwich Cove in Rhode Island.

It is obvious that the overplacement of plains may conceal the initial deposit and result in the formation of a broader plain enveloping a smaller one. The existence of such a buried plain could only be determined on seeing the cross-section wherein the top-set beds of the older would underlie the fore-set beds of the newer plain.

Boulders generally absent from wash-plains.— In the town of Rehoboth, Mass., is a broad morainal tract with knob and basin topography, thickly strewn with large boulders of the Carboniferous conglomerates. Nearly in the middle of this tract is a small wash-plain with a typical ice-contact on its northern margin. The plain is free from boulders. The ice-contact at the head of the plain shows

[1] See Facetted pebbles on Cape Cod, by Prof. W. M. Davis, in Proc. Boston Soc. Nat. Hist. xxvi, 1893, pp. 166–175; also Post-glacial eolian action in southern New England, by J. B. Woodworth, Am. Journal Sci. for January, 1894.

that it was built against the edge of melting ice; the absence of boulders from the plain shows that the boulders on the surrounding mounds did not come to their positions from floating ice, else some erratics must have dropped on the plain. While boulders are rarely found on the actual surface of sand-plains, they are frequently found at the same level on the surface of till continuous with the sand-plain topography, and boulders have been seen sparingly in the sand-plain itself, particularly near the head, as at Woodland, Mass., where a boulder probably floated out on ice in the early stages of deposition. One of the plains in the Narragansett Bay region is coated with angular blocks and some till indicating clearly an advance of the ice-sheet over the field. Even on the hypothesis that plain level was marginally at water level, it is rather surprising to note the absence of boulders from characteristic wash-plains.

The iceward margin of wash-plains.— The head or highest part of wash-plains is towards the ice or the source of the detritus. There are two classes of plains as regards the topographic features of their iceward margin, viz.: (*a*) plains with a terrace confronting low interglacial ground north of them; (*b*) plains, without terraces, confronting till-covered areas usually rising above plain level. These types are illustrated by the Nantucket plain on the one hand, and that of Martha's Vineyard on the other.

We sometimes find kames and eskers associated with plains having an iceward terrace; but kames and eskers are quite as frequently absent as present. We must, therefore, conclude that there is no necessary relation between the formation of kames and eskers and the pouring out of gravels and sands from the ice to make plains. It is important to perceive this want of dependence between intraglacial and extraglacial deposits in formulating an hypothesis for the stream action which produces the wash-plain.

As yet the manner of flow, in the ice-sheet, of the streams which produced the greater sand-plains, has received little light from studies on the ground. This is partly because the structure of our sand-plains is rarely exposed at the head or terrace in a manner to show the method of building. From studies conducted on the Woodland plain it appears that building went on along the entire front, quite regardless of the esker which joins the plain on Beacon street. There is a very rapid passage outward in the plain at the mouth of the esker channel from coarse gravels to fine sands. The appearance of the contact zone where seen in the plain is such as to show that the esker built up *pari passu* with the plain, and that there were streams flowing in or on the ice of which no record now remains in the intraglacial field. From analogy with the conditions of discharge in Alaskan glaciers, made known by Russell's studies, we might expect waters under hydrostatic pressure bursting out as "springs" along the marginal portion of the ice-sheet, thus breaking out on the surface of the ice where it would be easier to maintain an open passage than through the clogging sand in the contact zone of the plain. An abandoned channel of this sort, almost connecting with the plain but filling up with gravel and sand, would present the "notch" which separates some eskers from their wash-plains, a feature which forms at present the chief stumbling-block in explaining the relations of esker-channels to their fans.

GEOGRAPHICAL DISTRIBUTION OF THE WASH-PLAINS OF SOUTHERN NEW ENGLAND.

(The numbers in parentheses refer to townships on the map, Fig. 7.)

In the uplands of this region, sand-plains are practically wanting. If these deposits occur there at all it is in narrow north and south valleys in association with rem-

nant tongues of the ice-sheet rather than along its main front. In the broad lowlands of eastern Rhode Island and the southeastern part of Massachusetts, embracing all of "The Old Colony," wash-plains abound.

The age of the plains in this field is, in general terms, successively newer from south to north. The outermost plains fronting the terminal moraine pertain to the height of the last or third glacial epoch. The more northern plains belong to the retreat of the ice-sheet and fall within the time commonly known as Champlain. But there is reason for believing that till- and drumlin-making may have been going on, about Boston, while the plains in the latitude of Providence were being deposited, so shadowy is the demarcation between the Glacial Period so-called and the Champlain Period as originally defined. It would be more consistent to speak of the superficial glacial drift of this field as pertaining to the last or third glacial epoch, allowing the term Champlain, as seems to be the tendency, to become obsolete.

The distribution of plains in this lowland district of New England is at first sight without order; but amid the labyrinth of passages in the decaying ice, channels which are now marked by accumulations of gravel and sand, there are certain well marked and massive accumulations which upon examination on the ground arrange themselves in lines comparable to moraines. To a certain extent, morainal accumulations attend the wash-plains which are thus distinguished from the irregular accumulations of this nature. In the following pages, the most prominent of these retreatal lines will be indicated, and under the head of sporadic plains, are placed a few notes concerning deposits which may yet be arranged in a coherent system, but which are not at present distinguishable from the irregular disposition of gravels and sands about chance blocks of ice left in the general retreat of the glacier.

Plains of the terminal moraine. — The largest and best defined outwash plains in this region are those lying in front of the outermost or terminal moraine lying upon the New England Islands. The plain on Long Island has not yet been mapped. If a plain ever existed in front of the morainal accumulations on Block Island, it has long since been washed away by the sea. The plains of Martha's Vineyard and Nantucket[1] are well illustrated by the contour maps of the U. S. Geological Survey. These two plains are apparently contemporaneous, having been formed well within a reëntrant angle of the ice-front lying between lobes, for convenience designated as the Cape Cod and Narragansett Bay lobes, which were more sharply defined when the ice front lay north of the New England Sounds on the "back bone" of the Cape.

Nantucket plain. — The Nantucket plain (13) is an essentially eskerless, kameless, well-defined outwash delta or series of fan cones fed by streams coming from the glacier, the position of whose front is very clearly marked by the terrace at the northern margin of the plain. Near its head, the plain attains elevations of sixty feet above the present sea-level, these points, apparently marking the last layers of outwashed gravel and sand, being separated by furrows due either to the failure of adjacent fans to coalesce marginally, or, as can be proved in some cases, to creases marking the discharge of subglacial streams.

The former contact of this plain with the ice-front can be traced by alignment to Tuckernuck Island on the west, and so onward by the wave-washed isle of Muskeget, to Chappaquiddick island where small fans extend in a northwest line towards the larger island of Martha's Vineyard.

Nantucket presents us with perhaps the best and clear-

[1] Consult the Nantucket, Muskeget, Martha's Vineyard and Gay Head atlas sheets (in Massachusetts). A colored model of Nantucket on the scale of one mile to the inch has been prepared by Mr. G. C. Curtis of Brookline, Mass.

est example of terminal moraine topography in the eastern United States, for the reason that the underlying preglacial deposits have very little expression in the relief of the area. On Martha's Vineyard and in the westward extension of the terminal moraine, an older topography at almost every step accentuates the height and grandeur of the morainal accumulations; whereas, on Nantucket, the approximate extent and bulk of the moraine and its posi-

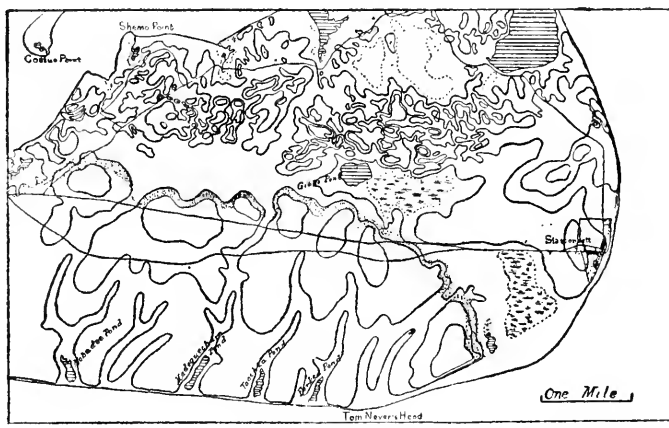


FIG. 3. A portion of the island of Nantucket, showing the frontal outwash plain with ice-contact slope (dotted belt between twenty and sixty feet contour-lines), the fosse or depression at the head of the plain, and the kame moraine or belt of mounds and kettles of submarginal drift. The contours represent some of the larger creases on the plain. Contour interval, twenty feet. (From U. S. Geological Survey, topography by E. B. Clark.)

tion with reference to the ice may be clearly discerned. (See Fig. 3.)

From the existence of a terrace at the head of the sand-plain which rises from forty to fifty feet above the depression or fosse on the north, it seems demonstrable that the ice-front lay along the head of the plain while deposition was taking place in the morainal tract proper. The knobs and basins moulded in the unstratified drift, then, are *submarginal* rather than precisely *frontal* in origin. In

restoring the glacial conditions, we should imagine the ice-front in contact with the head of the sand-plain, and the northern part of the island covered with ice rising as a gently sloping plain to the northward. From the front of the ice, rivers emerge laden with gravel, sand, and mud, as is the case with the plains confronting the Malaspina glacier to-day.

From the form of the plain on the east, it is thought that the ice-front turned southeastward and ran out over the Nantucket shoals. This interpretation is expressed in the accompanying map (Fig. 3), and on the general map of southeastern Massachusetts. (See 13, Fig. 7.)

Martha's Vineyard plain.—The Martha's Vineyard plain appears to have arisen in the angular space between the two lobes of the ice-front previously named. From Vineyard Haven harbor, the ice edge extended southeastward across Chappaquiddick Island in the direction of Nantucket as shown by the ice-contact delineated on the general map (Fig. 7). Topographic signs of this ice-contact exist on either side of Edgartown harbor. From Vineyard Haven, the ice front also extended southwestward lying for the greater part of its extent on the highlands of the island. At an earlier period than the time of sand-plain building, it is probable that the ice extended southward of the island; at least, as Professor Shaler has pointed out,[1] the southernmost part of this island and the neighboring island of No Man's Land are till covered. The position of the ice-front in the highlands of Martha's Vineyard is clearly indicated by *boulder-belts* (16), a type of frontal moraine accumulated on southward slopes where the fine materials were readily washed to the lower grounds. The position of the principal belt is shown on the accompanying map (16, Fig. 7).

[1] See his report on Geology of Martha's Vineyard, 1888.

Only in deep passes through the highlands, where the ice-base was low, did the construction of the sand-plain reach up to and above the base of the ice-sheet, hence the plain usually comes up against the rising slopes of the moraine without a definite terrace such as characterizes the Nantucket plain. Evidences of ice-contact are shown in the head of the James Pond depression (16) and again in a high terrace south of the state road at Sachem Spring in the region of Chappaquonsett Pond. There are fan-like forms, between the state road and the eastern side of Lagoon Pond and at an average radial distance of two and a half miles south of Vineyard Haven, which indicate the extension of the ice-sheet up to the arc, thus described, at a time just before the deposition of the Sachem Spring terrace.

The outer portion of this great plain is grooved by sharply defined drainage creases, some of which are traceable up to the line of the moraine. Other creases appear to have been originally thus extended but to have been later choked up by the outpouring of gravels and sands along the ice front.

This plain, like that of Nantucket, has, at the present time, an average slope of about twenty feet to the mile. Its inner margin attains an elevation of one hundred feet above the sea. It is relatively free from ice-block holes, one such depression existing one and a half miles south of the southern end of Lagoon Pond (15). Kettles are, however, not wanting in the morainal or intraglacial field of the time of deposition.

Plains of the Cape Cod moraine.—A well recognized line of moraine begins on Cape Cod, in Orleans (4), and extends west-by-south next the shore of Cape Cod Bay, curving northward to unite with the interlobate line of moraine skirting the eastern shore (12) of Buzzard's Bay. At the point of union (10), thick morainal deposits extend

northwards in the form of an interlobate moraine to and beyond Plymouth (17, 53). The Buzzard's Bay moraine caps the Elizabeth Islands and is then lost at sea, but probably appears westward in the Charlestown moraine skirting the southern coast of Rhode Island.

A broad plain (6–12) skirts the southern side of the moraine on Cape Cod, combining features which have been described on Martha's Vineyard and Nantucket, with the addition of numerous lakelets and kettle-holes which here take the place of the fosse on Nantucket.

Traces of what appears to be an earlier, temporary halt of the ice-sheet with deposition of small plains are shown along the southern coast of Barnstable (9) in situations which have not been suffused by the outwash of sands and gravels from the principal moraine. Two such deposits are shown on the annexed map of the Great Pond area in Barnstable (fig. 4).

A diagnosis of this plain in comparison with those of Nantucket and Martha's Vineyard is interesting in showing the irregularity of the melting of ice along the front and in the determination of the place in which the morainal wall proper was built.

The annexed map of the Great Pond region in Barnstable shows by the contours of the plain, as the author has been able to ascertain on the ground, that the ice-sheet probably overlay the morainal wall and lay in the lake area as late as the closing stage of sand-plain construction. The high terrace skirting the eastern border of the pond shows a marked slope away from the pit with a maximum point, the apex of the alluvial cone, designated by the eighty feet contour at the northeast corner of the pond. An examination of the map will show the reader that the plain slopes away southeastward, southward and southwestward from the respective sides of the ice-block hole. The association of the later local fans,

with what appear to have been blocks of ice or protrusions from the main mass, suggests that there was much detritus in the ice or on its surface, or that these special areas were the outlets of the drainage from above the base of the ice sheet. The occurrence of an esker-like ridge

FIG. 4. A portion of the Barnstable atlas sheet, showing the morainal wall on the north and the wash-plain on the south enclosing Great Pond. Deposits of earlier drift form knolls and hummocks along the south shore. Contour interval, 20 feet (from U. S. Geol. Survey).

in Great Pond recalls the features of the Saylesville esker (87) and lateral terraces in Rhode Island (Fig. 1), as well as the like features of Cunliffe Pond near Providence.

The Elizabeth Island moraine presents no outwash plains above the sea-level. The moraine itself, according to investigations carried on by C. W. Coman under Professor Shaler, overlies stratified drift, which appears to be of an earlier date than the halt of the ice-sheet at this line. Neither is a sand-plain developed above sea-level in front of the Charlestown moraine. From analogy of this line of moraine with the similar deposits on Nantucket, we should expect to find the sand-plains of that stage from half a mile to a mile south of the moraine and beneath the present sea-level in these areas, the moraine itself being a submarginal deposit.

Plains of the Narragansett Bay region.—The principal features of the numerous plains in the Narragansett Bay area have been described in my paper of 1896. They need be referred to here only in connection with the lines of retreat which they mark.

The Middleboro moraine.—The southeastern border of the Carboniferous area from Fall River eastward is more or less topographically shown by a low elevation of granitic hills. Closely following this line and in the sedimentary, lower area is a recognizable line of glacial, frontal accumulations, perhaps best shown at Middleboro (30), where, east of the town, morainal hills, with crumpled gravels, lie on the northwest border of stretches of sand-plain extending southeastward. This type of topography extends northeastward to Kingston, beyond which it merges into the complex morainal and fan-cone topography of the Plymouth interlobate moraine (32). Numerous streams head in the belt, flowing to the southeast or northwest, and showing manifest derangement by the distribution of the deposits. The Lakeville lakes (28) lie on the outer margin partly enclosed by earlier drift. Great Cedar Swamp lies in the unfilled area back of the morainal line.

Southwestward (27) towards Fall River (24), frontal deposits are traceable in the terrace from that city to Tiverton, and again in the partly submerged sand-plain at Tiverton Bridge (91) on the island of Rhode Island. The deposits along this line are notably stronger and show more signs of ice action as we approach the region of the interlobate moraine on the west shore of Cape Cod Bay.

The Providence-Bridgewater line.— A fairly distinct line of morainal accumulations with outwash plains extends from the narrows, at Providence (42), northeastward, through Rehoboth (40), Taunton (37), Raynham (36), Bridgewater (35), and so to Pembroke (51), in the North River region, joining the Cape Cod Bay lobe near the Coleman's Heights (57) sand-plain which was built at the margin of that lobe.

The Bridgewater locality exhibits perhaps the most unique of these deposits near Boston. Sprague Hill (50) the site of a water-tower, is the culminating point of this morainal line. The highest point of the mass appears to be the apex of a large cone built at the ice-front. The northern slope of this hill has all the features of the ice-contact, in its steep slope, in the coarseness of the detritus, even boulders being occasionally present as in the morainal terrace of Gilbert. From the ice-contact the deposits fall off rapidly southward in long finger-like lobes, ending on a terrace, which appears to mark a water level in the region. The cone above described appears to have been built above water level. Westwards, near the railroad, sand plains occur, with the ice-contact well developed.

About one-quarter of a mile north of this ice-contact line there appears, east of the railway track, an area of typical morainal topography and deposits. A few cuttings show that the till is locally not more than three to four feet thick and that it overlies water-worn drift of

a rather coarse type. We have here repeated the cross-section of frontal or submarginal deposits which appears so distinctly on Nantucket, viz.: going from south to north, (1) an outwash plain; (2) the ice-contact, a terrace overlooking low ground which may be designated as (3) the fosse, occupied by undifferentiated drift, frequently bouldery; and followed by (4) morainal mounds, with till and underlying wash, to which succeeds on the north the ordinary ground moraine.

If we suppose that the morainal mounds were built at the front of the ice when its edge lay on their northern side, then we have no contemporaneous wash deposits attributable to the discharging streams. It is more rational to suppose that the morainal mounds accumulated under the ice when its front lay along the wash-plain heads, thus correlating extraglacial plain-building by drainage with intraglacial mounding of till by forward ice movement.

The superposition of till on stratified drift in these morainal mounds in the intraglacial field has elicited two alternate hypotheses, viz.: 1. The deposit is due to the overriding of a small gravel outwash fan built on the site of the mounds in a stage of the ice retreat immediately preceding the Bridgewater stage, when the ice front was along the northern edge of the present morainal area. Outwash fans tend to occur in isolated forms. The overriding action of the ice would mantle them over with till and destroy the form of the original deposit. 2. After a wash-plain has grown up at the ice margin, it forms a mass resisting the forward motion of the bottom ice. The upper ice would tend to shear off from the stagnant prism lying behind the sand-plain head. At the point where the bottom of the live ice began to move up over the inclined plane thus formed, the subglacial till would

tend to clog in the plane between the live and dead ice. There might thus be established one of those masses of till involved in the ice which Chamberlin has described in Greenland. On the subsequent melting out of the ice, the unequal thickness and rate of lowering of this till to the ground would result in mounds. This hypothesis accounts for the till in the submarginal moraine but does not account for the underlying waterworn gravels. On this account, the first hypothesis is preferred.

Mr. H. T. Burr, a student in Harvard University, has traced this line of ice-front several miles to the northeast.

The Wrentham-Weymouth line of lakes. — There is a prominent line of glacial lakes extending in a northeast and southwest direction from near the northeast corner of Rhode Island to Weymouth, Mass. These lakes are as follows, beginning on the southwest: Shepardville Reservoir, Shepard's Pond, Cocasset Pond, Neponset Reservoir, Billings Pond, Massapoag Pond, ponds and reservoirs at Canton, Ponkapoag Pond, Great Pond, Little Pond. These lakelets are simply the water occupied portions of low areas partly surrounded by plains of sand and gravel. No attempt has been made to map this line of apparent ice-front and further study is necessary to show that the plains are not merely fans fringing ice-blocks.

The enclosing plains form a line of deposition not readily separated from the wash-plains referred to in this paper as the Woonsocket-Sharon line described below. By the frequency of the three-hundred feet level on some of these deposits from East Foxboro northward towards Sharon, it seems probable that further study will show a connection between the plains dependent on water-level in this field.

The Woonsocket-Sharon line of deposits. — A fairly

well defined line of wash-plains can be traced from the south side of the Blackstone River at Woonsocket northeastward to the southwest corner of the Blue Hills. The Woonsocket (70) outwash plain stands at an elevation of about three hundred feet above the sea. At Sharon (64) there is an extensively developed plain also at an elevation of three hundred feet. A few miles northeast (82) of this plain begins the deposit built along the edge of the ice when the Neponset valley was occupied by the retreating front. This deposit has an elevation varying from 140 to 150 feet above sea-level. At the base of Little Blue Hill, the plains of this stage have been suffused by a fan supplied by the drainage coming through the pass between Little and Great Blue Hill, evidently after the retreat of the ice from the Canton stage, but while the sheet still clung about the northern base of the Blue Hill range.

Immediately north of Canton Junction station, the head of the plain of this stage shows grouped terraces and the intraglacial ground is heavily strewn with boulders dropped from the melting ice. The Neponset valley with its marshes thus represents an unfilled area whose existence as such depends upon the position of the ice front. About Islington (81) on the west side of this depression, there are local plains and eskers, but the development of plains along this western line was so feeble that the Neponset valley was scarcely invaded by them.

North of the Woonsocket-Sharon line of plains lies the Mechanicsville esker-fan in the town of Bellingham. As shown in the accompanying figure, the esker and the notch in this deposit are abnormal, the esker in its breadth and the notch in its depth. The notch gives passage to a stream and a pond lies in the axis of the esker at the head of the plain, showing that the ice-wall was intact the entire length of the plain. It seems likely as noted on p. 87

that the observations of Russell on the Malaspina glacier fountains may afford an explanation of this case, for if the subglacial drainage found its way to the surface of the margin of the ice through a crevasse or hole when the lower end of the subglacial streamway became clogged, a break in the continuity of the esker-fan and the esker would be expected.

The Newtonville-Woodland wash-plains.—The Newtonville esker-fan described by Professor Davis and modelled by Dr. Gulliver lies south of the Charles River apparently in line with larger wash-plains lying between Woodland and Waban stations on the west. The Woodland plains are complex in structure, showing the phenomena of ice-retreat and the overlapping of newer plains on those previously laid down.

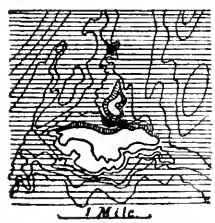


FIG. 5. The Mechanicsville wash-plain with the esker-like deposit north of it. The "notch" between the esker and the plain is followed by a stream and is occupied by a pond. (Topography from Franklin atlas sheet, U. S. Geol. Survey.)

Southeast of Waban station stands a ridge of gravel and sand with an ice-contact slope on its northwestern face with typical coarse detritus in the contact zone. The opposite side of the ridge is lower, slightly lobate, and the detritus finer. The inclined surface of the deposit suggests that we have in this case an alluvial cone built at the ice edge. The deposit is lengthened parallel with the ice contact.

The Cambridge moraine and plain.—Old Cambridge lies upon a plain of sand whose northern limit is a well defined ridge extending from Porter's Station southwestwards by the Harvard Observatory and thence westwards along the southern border of Fresh Pond to the Watertown line.

This ridge rises at three points to the uniform height

of eighty feet above the sea and has an average elevation of forty-five feet above the plain on the south. It is a complex structure of glacial materials. The core of the ridge is clay apparently pushed up from the area on the north. On the south side of the ridge, as in the vicinity of French Pond Lane, a sheet of washed gravels declines southward from near the top of the ridge. Locally, along this crest, the southern slope of the ridge is rudely stratified as if by the overwash of waters from ice lying on the north. Just west of the Watertown branch of the Fitchburg R. R., at the point where it passes through this morainal ridge, the bulging front of the ridge is strongly morainal in form.

On top of the clays, throughout the extent of the ridge, is a thin deposit of glacial drift composed of boulders and small fragments derived from the slates and igneous rocks in the Boston area and on the north of it. These materials are frequently ice-scratched.

This ridge is at the southern end of the line of ice-block holes with attendant wash-plains which begins in Fresh Pond and extends northwards through Spy Pond in Arlington to the Mystic Lakes, the Winchester Ponds and Horn Pond in Woburn. The moraine bordering Fresh Pond indicates that there was a slight forward movement of the ice on the line of the Woburn-Arlington depression, causing the ice to excavate the underlying clays in Belmont and Cambridge. This movement lasted perhaps somewhat later here than the disappearance of the ice in the drumlin area to the eastward in Somerville.

Kames on the west side of Fresh Pond, as pointed out by Professor Crosby in 1889, show marked signs of overriding by the ice. The annexed figure represents a sketch of folds in the gravels observed by the writer on June 7, 1891. Further evidence of ice movement in this

same side of the pond has been frequently observed in the heads of clay which protrude into the overlying gravels. These masses sometimes rise up as much as ten feet above the level of the pond. In one part of the section a bed of clay was forced up with the gravels into a broad arch as shown in a recent report on the Cambridge clays.[1]

The frontal wash-plain has an average elevation of about thirty feet above sea-level. It is pitted by broad shallow depressions most of which have disappeared under the extension of streets and buildings and through the action

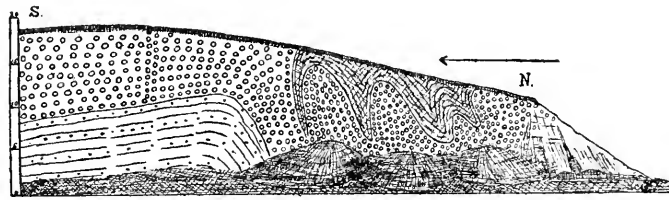


FIG. 6. Section (now destroyed) on west side of Fresh Pond, as seen June 7, 1891, showing folded and eroded gravels. The arrow indicates direction of ice motion. Elevation in feet.

of peat-making plants. One such peat-bed was encountered in laying the foundation of the botanical section of the University Museum on Oxford street.

Several glacial deposits of an earlier date than the plain interrupt its extent. The knoll of till in Harvard College yard, extending to Dana Hill, is such a mass, as are also the partially graded kames in Mt. Auburn cemetery. There are no contemporaneous kames or eskers associated with the plain. It appears to have developed largely as overwash and outwash from the moraine before mentioned. The cuts in the plain formerly exposed in

[1] See Shaler, Woodworth and Marbut; 17th Annual Report, U. S. Geol. Survey, pt. i, p. 990, fig. 37.

the pits on North avenue (now so-called Massachusetts avenue), near the car stables, revealed frequent reversals of cross-bedding of the tidal sort, giving the impression that the plain was formed beneath sea-level. The extension of the plain eastward into Cambridgeport favors the same view, but no decisive facts have been gathered to exclude the hypothesis of a glacial lake at the level of about thirty feet above the present sea-level. In connection with this higher water level, it should be mentioned that there is, in the outer margin of this plain, a distinct furrow or crease, occupied by Willis Court, which joins the Charles River at Gerry's Landing. This old drainage furrow is now partly submerged by the Charles and occupied by marsh deposits.

Sporadic plains.—Between the lines of dominant sand-plains and moraines outlined in this paper there occur sporadic plains built without definite arrangement between and around masses of melting ice. Until the actual ice-contacts in this area are carefully plotted and the superposition of wash deposits has been made out, further mention of these deposits can be of little more value than to guide students to them. The following notes are recorded for the sake of those who desire to undertake the study of promising localities.

On the Taunton sheet the mass of gravels on the southern border of Cedar Swamp should be examined. The course of the Three Mile River from Norton reservoir southeastward to Taunton appears to be determined by constructive depressions between sand-plains.

On the Abington sheet, the shores of the numerous lakes and so-called ponds are invariably formed by wash-plains. The course of the North River is through a region of plains and morainal mounds. Monponsett Pond, on the south, is one of the saddle-bag type, like Cunliffe

Pond. A well-defined esker divides the lake into two lobes. On the eastern and western sides of the pond are wash-plains.

At North Pembroke, plains are developed in succession on the south side of the North River. Long Hill, on the east of the town, is a high plateau apparently of wash origin. A well-formed wash-plain rises above the village immediately east of the principal street. It should be noted that a well-defined esker comes down the hill on the north of the river and passes beneath the swampy stream at a point opposite the mouth of Robinson's Creek.

The plains in the northern part of this atlas sheet have been described by Crosby and Grabau in connection with Lake Bouvé.

Numerous deposits on the Duxbury atlas sheet are resolvable into high plains and cones of washed gravels. Everywhere steep slopes marking ice-contacts appear.

On the Plymouth sheet, there is a double alignment of ice-block holes and lakelets. One line runs northwest at a distance of two or three miles from the shore of the Bay and includes the following ponds, beginning on the north: Smelt, Triangle, Billington Sea, Cook, Great South, Boot, Gunner's Exchange, Crooked, Long, Halfway, Bloody, Little and Great Herring. Springing out from this line and extending southwestward are at least six marked lines of ponds beginning with Buttermilk Bay on the south. Next come White Island, Glen and Spectacle ponds; farther northwest is a line of lakelets running southwest from Crooked Pond of the main line series; another set intersects the main line in Great South Pond. Billington sea has a spur in West Pond; Triangle Pond in the main trend is in line with Round Hole, Clear and Darby ponds. The ponds in the main line have their axes northwest and southeast; those in the spurs are

elongated in the direction of the cross-lines, northeast and southwest. Between the lines of ponds are broad, high plains, mainly sloping southwestward. The deposit between the Great South chain of ponds and the Crooked Pond series is the most pronounced. The ponds mark ice blocks. The plains mark valleys in the ice filled with detritus. The Monument River depression partakes of the character of the northeast and southwest lines of ponds, but has been scoured out by running water. The full interpretation of this interlobate morainal area promises to throw much light on the formation of plains about ponds.

The Middleborough sheet presents many sporadic plains with lakes and swamps.

THE WATER-LEVEL OF WASH-PLAINS.

A stream of water flowing in a trench and scouring its bottom will begin to deposit its load on encountering a deep hole. A sub-aqueous delta with a lobate front and flat top will form in such a place. This deposit will build up to a level at which the velocity of the current for the depth of water is at bottom sufficient to drag to the lobate margin the particles which the stream brings to the place. These particles are hurried along and dropped in the talus at the end. With constant velocity and load, the delta builds uniformly forward. The height of the plain in this case is not *directly* determined by water-level, but it is *indirectly* related to it in so far as water-level depends upon the cross-section of the stream, depth of water, velocity, and width of channel. It has not been shown as yet that any wash-plains in this region have developed under conditions similar to those above indicated.

Streams heavily laden with detritus and pouring out from declivities on to low grounds above baselevel build cones with slopes at angles dependent on relation of load

to stream volume, with a tendency to approach the dry talus at one end of the series and the alluvial fan at the other end of the series. In this field there exist several peculiar deposits, usually ridge-like in habit, but differing from eskers in that they extend east-west, or north-east and south-west while neighboring eskers extend north-south; and in that they have a typical ice-contact on their northern or iceward sides, and a deltate or lobate topography on the opposite southern side. There is usually a steep slope from the summit line of the ice-contact slope to the outer margin. The deposits not infrequently have one high apical point along the ice-contact. They are deposits of the subaërial type in most cases, although marginal delta lobes would in other cases point to standing water about their bases. Both the Bridgewater cone, known as Sprague Hill, the deposit at Walpole Junction and that southeast of Waban station point clearly, it seems to the writer, to the subaërial construction of the upper prism of these deposits.

If the topography of an existing alluvial plain deposited in a water-body may be taken as affording evidence of water-level, the summit line or brow of the lobate margin is at water-level. On the margin of such a deposit, lobes are built by different streams at the same time or by the same stream at different times since a stream may wander from side to side of the fan; hence, since the water-level may vary, the lobes of such a plain may occur at slightly different levels. The instances pointed out by Salisbury in Lake Passaic, New Jersey, probably fall within this class of effects. The elevation of the summit line of multilobate plains thus becomes of importance in determining water-levels. It is the southern and outer rather than the northern and iceward margin of the plain which is taken into account. In most plains the level of the

middle of the plain as given on maps is probably a fair elevation to assume for water-level.

Taking this level for data, we obtain the following results on two lines of wash-plains going north, one in the Connecticut Valley area, the other in the Narragansett Bay region. The elevations are taken from the U. S. Geological Survey atlas sheets.

A. In the Connecticut Valley region.

PLACE OF DELTA OR WASH-PLAIN.	LATITUDE.	DISTANCE FROM COAST AT SAVIN ROCK.	ELEVATION ABOVE SEA.
1. New Haven.	41° 18′	3 miles.	15 feet.
2. Bristol, Conn.	41° 41′	29 "	650-670 feet.

B. In Narragansett Bay region.

PLACE OF DELTA OR WASH-PLAIN.	LATITUDE.	DISTANCE FROM COAST AT POINT JUDITH.	ELEVATION ABOVE SEA.
1. Slocumville, R. I.	41° 32′	11 miles.	160 feet.
2. E. Greenwich.	41° 38′	20 "	50 "
3. Barrington.	41° 44′	27 "	50 "
4. Saylesville.	41° 53′	37 "	107 "
5. Attleboro, Mass.	41° 56′	40 "	140 "
6. Woonsocket, R. I.	41° 59′	45 "	300 "

If we suppose the two deposits cited from the Connecticut valley area to have been formed at sea-level, we must assume a postglacial tilting to the northward of 25 feet to the mile, a result so far abnormal as to exclude the supposition. Moreover, this view forces us to hold to a

submergence of over 650 feet at Bristol, Conn., while at Bristol, R. I., in the same latitude, the nearest wash-plains would indicate a submergence to a depth of about 50 feet. Other anomalies, if we hold sea-level to lie rigidly at delta plain level, appear in the Narragansett Bay region as I have pointed out in another paper. There we have the Slocumville plain at 160 feet in the hills, followed by plains at 50 feet in the low now open grounds; and the Attleboro deposit at 140 feet in the low grounds with the Woonsocket deposit at 300 feet in the hills and only five miles farther north. In this latter case, we should have a tilt rate of 32 feet to the mile!

It may be objected to the above statement of the marine limit hypothesis that the high plain at Woonsocket for instance was built during the deeper submergence which attended the going off of the ice, while the low level plain at Attleboro was deposited later when the land, unladen of much ice, had risen higher. But this argument is met by the rather decisive facts in the glacial history, showing that the Woonsocket deposit belongs to a line of retreatal moraine formed later than the Attleboro accumulation. The attempt, therefore, to interpret sea-level by a rigid application of the criterion of wash-plain level involves us in hopeless inconsistency, sudden changes of level, and the need of having the sea at different levels at the same time in the same region.

If the water-level index afforded by delta fronts means anything at all, it seems to point to local bodies of water standing at levels dependent on local topographic conditions as in temporary glacial lakes or flooded areas by which I mean bodies of water formed in basins where the rise of the water is due to the excess of inflow over outflow, however brought about. The occurrence of plains in high grounds along the south coast as well as on the

low grounds along essentially contemporaneous ice-fronts shows that sea-level could not have afforded the control which has limited the upward growth of wash-plains. This view of course does not exclude the possibility of certain low-lying plains near the coast being deposited under the marine limit; but the wash-plains themselves have not as yet, it seems to the writer, been made to furnish the criteria of marine deposition. Beaches, fossils, and wave modified glacial deposits are much better indications of submergence than deltas which are in this region identical in form and surroundings with similar glacial accumulations found under circumstances where no submergence is supposed to have taken place.

STAGNATION OF ICE-SHEET.

The mode of deposition of the wash-plains and accompanying morainal deposits above outlined in this paper affords a clew to the relative areas of stagnant and live ice during the retreat of the glacier across this field. The facts demanding stagnation are found in the numerous ice-block depressions and in wash-plains with heads which show no forward movement of the ice-sheet, either by the failure of shoving in the gravels or by the lack of morainal deposits in the terrace at the wash-plain head. The facts demanding live ice at intervals during the retreat are the lines of boulder-belts, positions marking halts of the ice-front during which backward melting equalled forward movement. A similar demand is made to explain displaced and overridden glacial deposits, as in the case of the Fresh Pond area in Cambridge. It will also be shown that the distribution of prominent belts of wash-plains can only be explained on the supposition of a forward movement of the ice.

The picture presented by Professor Davis of the marginal portion of the ice broken up into isolated blocks around and between which streams deposited gravels and sands is again and again forced upon the mind in the lowland of the state and in the valleys in the uplands. These ice-block holes as the bergs now present themselves to us, like the sands which surround them, do not mark a single phase of the retreat. As in the Narragansett Bay region, the drift phenomena are increasingly newer as we go northward. The repeated overlap of the lobate front of one wash-plain upon the esker and kame deposits of an earlier stage to the southward is sufficient evidence of the general truth of this statement. This mode of retrogression of the front is what we should expect in the case of an ice-sheet thinner on its margin than in its central part. The existence of recessional wash deposits does not therefore of itself disprove the idea of a period of general and complete stagnation of the ice over this area. But when we consider the evidence of forward movement of the ice at several successive lines across the eastern part of the state as in the Middleboro, Providence-Bridgewater, and Cambridge moraines, it becomes evident that the ice-sheet as a whole did not lie stagnant on the area. There were periods of marginal inactivity, accompanied by the tunneling of running water, esker-building, terrace and plain construction, with a general retreat of the main front, followed by seasons of advance, with the shoving of drift deposits, the spreading of till and boulders over wash-plains.

The occurrence of the several morainal patches with wash-plains in lines which traverse the area between the head of Narragansett Bay and the south side of Boston Bay is further evidence of forward movement in the ice sheet. These lines of frontage obey the law of marginal

lobation, by which the equalization of pressures in the ice along the front maintains a convex outward curve.

From all these considerations it seems to me possible to conclude that the ice-sheet retired from southern New England at least as far north as the Cape Ann boulder moraine while the main mass was still live ice.

DECOMPOSITION IN WASH-PLAINS.

The retreat of the ice from this field was so recent that the general form of the deposits and most of their details remain unaltered. Owing to the openwork structure of the wash-plains, and to the fact that the clays made at the same time were carried off into deeper water, the sands allow the rain water which falls upon the plains to sink through instead of running over the surface and cutting trenches. While the deposits are thus by their structure protected from erosion, they are subjected to chemical alterations by the action of the water which passes downward through the soil. In this region, where the plains are largely built of particles of feldspathic rocks, most pebbles contain solvable minerals which sooner or later go to pieces.

Croll[1] has pointed out the fate of glacial deposits strewn over the land surface and so left for an indefinitely long period without preservation by burial beneath overlying strata. Glacial drift so left must gradually waste away, going to the sea mainly in solution, while quartz vein pebbles and the quartz of the granitic rocks alone will remain to make pebbly beds, in which there may remain no distinguishable feature of glacial origin. The beginning of this change is already far advanced in the glacial deposits even in the latest in the latitude of Boston.

[1] Climate and Time, chap. XVII.

Professor Shaler, in his report on the Geology of Nantucket, has presented a study of decay in the glacial deposits of that island the leading features of which changes I cite in his own words:[1]

"Perhaps the most noteworthy feature in these deposits of drift is the very extensive decay to which the pebbles and sand have been subjected. Some of the consequences of this decay will be noted below. In their form and structure, the drift deposits in no distinct way differ from the similar accumulations found in the region a hundred miles farther north, but in their state of preservation they present important differences. The decay which has attacked the pebbles is exhibited in the following ways, viz.: (1) By the interstitial decay of the stone, which manifests itself in the crumbling of many of the varieties of crystalline and fragmental rocks; (2) by the dissolved look of the surface of the rocks which resist the interstitial decay; and (3) by the development of the incipient joint planes in the pebbles, so that, though they may be but little decayed, they often split into fragments on being removed from their bed."

An examination of the pebbles in some of the wash-plains near Boston shows the presence of similar effects due to chemical action. The most conspicuous example which has fallen under my notice is the case of the overridden deposit or "kame" on the west side of Fresh Pond, in which thousands of pebbles break down into angular pieces or have been so far leached out as to crumble into a rusty red powder when released from the bank.

In the Woodland wash-plain, the following changes in the section lying above the water-plane in the gravels have been observed. In the first place, pebbles lying near the surface of the deposit in the top-set beds and having

[1] Bull. 53, U. S. Geol. Survey, pp. 21–22.

veins of carbonate of lime have invariably been robbed of these veins by the downward percolation of rain-water charged with acids from the soil and the air. Now and then, the interior of a pebble exhibits a remnant of one of these veins as a deliquescent lump of calcite marked by spoon-shaped inosculating depressions, the characteristic mark of solution. Deep clefts are frequently opened up along the cleavage planes of the calcite. The cavities in many pebbles, thus formed by the removal of calcite, constitute from a tenth to a fifth by volume of the rock. Thousands of pebbles exhibit the same abstraction of carbonate of lime.

Associated with but underlying this pebbly zone of solution is one in which the pebbles exhibit the redeposition of the carbonate of lime. This deposition of the lime carbonate takes place as in the case of stalactites in caves, on the under side of the roof-like surface of the larger pebbles which rest upon coarse sands below. A crust of lime carbonate thus forms cementing the underlying sands to the overlying pebbles. On top of the pebbles which carry this lime crust is usually to be found a film of dust, the mechanical load of the percolating water. A few pebbles become encrusted over their entire surface with carbonate of lime.

This action is most noticeable in the northern or head portion of the wash-plain, where the gravels are relatively coarse. The lime carbonate layer is not more than five or six feet below the surface in some instances. It suggests itself that the agricultural value of wash-plains might be enhanced by penetrating to this lime-bearing zone and returning the carbonate of lime to the soil by accumulating heaps of the gravels from which the lime would slowly, by the action of the rains, work its way into the surrounding top soil. After such gravels have been

leached, they may be returned to the pits whence they were taken. By carefully working over the field so as not to have more than a few pits open at one time, the whole area might in the course of a few years be replenished with lime carbonate at a small loss of acreage exempted from cultivation by the pits and gravel heaps.

A rare occurrence of an analogous series of changes is the deposition of green carbonate of copper on pebbles, the copper having come from the breaking up of sulphides of that mineral in the overlying pebble layer.

The iron-bearing rocks and particularly those which carry both iron and lime, as in the case of the basaltic rocks and the diabases of the region, have frequently undergone decomposition to the point of losing their identity. The rusty pebbles feel light or have partly fallen to pieces regardless of their joint planes. In extreme cases, nothing is left of the contour of one of these pebbles but the network of quartz veins which it contained.

The segregation of oxides of iron in the outer crust of diabase pebbles sometimes takes place. This crust becomes heavy and limonitic, with a bluish black tarnish. A further stage in this line of alteration shows a yellowish powdery center surrounded by a dark brown crust, traversed in every direction by irregular wandering cracks gaping at the surface and dying out inwardly, the greater fractures only intersecting the nucleal portion of the pebble. These cracks are undoubtedly due to expansion consequent upon the oxidation and hydration of the iron in the interior of the pebble. Such pebbles exposed to the air and frost speedily crumble into dust.

Owing to the low stand of the sand-plains, their bottoms generally lying at or below base-level, the streams have not cut down near them so as to expose their floor, and so only here and there do we see signs of accumula-

tions of chemical waste such as give rise to sands and gravels cemented by iron oxides in other fields. In fact, there are few or no instances in which the consolidation of considerable masses of the glacial gravels have been observed in this area. Such consolidation as I have observed has most conspicuously taken place in a series of gravels and sands antedating the last glacial advance as on Martha's Vineyard and Block Island.

The result of the loss of materials in the upper parts of our glacial sand-plains by chemical solution must in the end become apparent in the lowering of their mass. If the action is uniform, the skeleton pebbles will crush and settle down into the open spaces below. Owing to the openwork structure of the gravels, the falling of the decayed pebble matter into the spaces remaining between the sound quartzose pebbles might lower the surface of the ground several feet. Since the pebbles and the consequent openwork structure are mainly developed at the head or in the ice-contact zone of the plains, this part will undergo the greater amount of settling from solution and crushing of the skeleton pebbles. For this reason important topographic bench marks should not be located upon the table-like deposits of this class nor should permanent and weighty stone structures be built upon these terraces. The falling in of the surface of these deposits, if it should occur, can hardly be discriminated topographically from the effects of the pronounced caving in which took place shortly after their deposition from the melting out of masses of ice.

The rate of solution of carbonate of lime under the conditions in which it exists in these wash-plains has not been determined. It is quite certain that, when the pebbles were brought to their position in the deposits, the veins of carbonate of lime were intact. We can ascer-

tain exactly the amount of carbonate of lime which has been removed. In those cases where some of the veinstone still remains, from an extended series of observations there might be determined the rate of solution and so the duration of the post-glacial interval.[1]

ECONOMICS OF WASH-PLAINS.

The wash-plains of this region play a very important rôle in the settlement of the country. Professor Shaler has noted the choice which they offered, to the early settler, of flat lands freed from the boulders encumbering the till-covered uplands. Although the wash-plain soils are sandy and relatively dry, the small amount of labor required to put some of the less elevated ones into the cultivated state led to their early occupation. Their formation has, in many instances, led to the production of wet woods and bouldery swamps in the intraglacial ground between successive plains, as at Foxboro, Mass., on the Shore Line Railroad, where the only available dry ground is a wash-plain.

In the suburbs of cities, the wash-plains afford vast stores of gravel and sand used in the construction of masonry and walks. The peculiar and regular structure of these deposits makes it possible to give directions for the search after sands and gravels. Coarse gravels will be found in the ice-contact zone, normally the northern aspect of the deposit, and in the top-set beds. The lobate margins afford supplies of the finest sand which the deposit holds. From these observations, it follows that a search for gravels should be begun at the northern side; for sand, at the southern side of a wash-plain. By stripping off the top-set beds, a supply of moderately fine sand

[1] On the decomposition of rocks, see Rocks, Rock-weathering and Soils, by George P. Merrill. New York, 1897, Part III.

may frequently be found for many yards northward of the frontal lobes.

The wings or lateral lobes even along the ice-contact sometimes afford sand as fine as that found in the southern part of the plain and for the same reason that the stream coursing over the delta was here at its end in deep water.

Kettle-holes have frequently become the site of small, post-glacial peat deposits, and of fine, loamy sands washed out by rains or borne by the winds from the coarser gravels of kames and plains. These fine sand deposits, since they are usually available without the labor of preparation by sifting, are locally resorted to for masons' supplies.

CONCLUSIONS.

From the general studies presented in this paper, the following conclusions have been arrived at by the author:

1. The wash-plains of southeastern Massachusetts are noticeably arranged in northeast and southwest bands, which correspond to morainal deposits marginal to an ice-lobe retreating across the region immediately west of Cape Cod Bay.

2. The Providence-Bridgewater line of these deposits presents well-marked submarginal and frontal moraine phases indicating that the marginal portion of the ice-sheet at this stage was in motion.

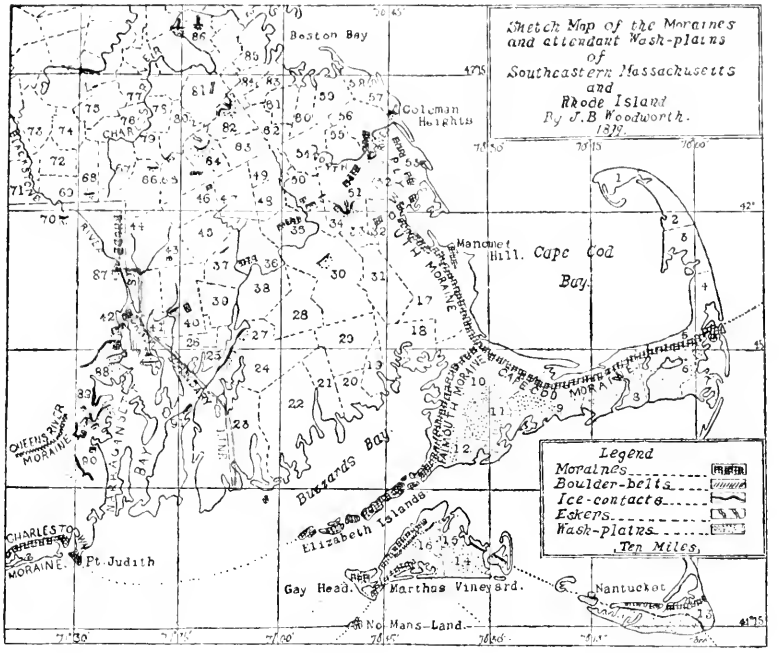
3. The alignment of the wash-plains as a whole is indicative of the retreat of the ice as a sheet characterized by stagnation only in isolated blocks and at certain stages of clogging with washed debris in and about its marginal portions. The excessive accumulation of this debris may have given rise to local stagnation in marginal portions of the ice base.

4. The extraglacial wash deposits assume forms explicable as deltas, fans and cones, some of the plains being

built approximately at water-level, some of the cones being built up above water-level. On the assumption that delta fronts are indicative of water-level, the very diverse altitudes of plains along the same line of retreat and in the same limited area separated in construction by the shortest possible space of time, makes it highly improbable that the water-level was also sea-level. It is more reasonable to suppose that the limit of construction of wash-plains was determined by the level of local bodies of water on a land area as claimed by Crosby and Grabau, or that, if the region was submerged, wash-plain levels have, as apparently held by Professor Shaler, no definite relation to sea-level.

5. As having a bearing on the rival hypotheses just named, an examination of the area shows that numerous blocks of ice remained long in the field to embarrass a land drainage and to produce temporary lakes.

The accompanying map, on account of its small scale, has not been made to show many wash-plains which surround ice-block holes. The features which are new are the morainal accumulations running northeastward from Providence and the line of plains following the same direction from Woonsocket in the northeastern corner of Rhode Island.



EXPLANATION OF MAP, FIG. 7.

The numbers refer to towns. Those mentioned in the text are as follows: 5, Brewster, east of which lies Orleans; 6, Harwich; 7, Chatham; 8, Dennis, west of which is Yarmouth; 9, Barnstable; 10, Sandwich; 11, Mashpee; 12, Falmouth; 13, Nantucket; 14, Edgartown; 15, Cottage City; 16, North Tisbury; 17, Plymouth; 24, Fall River; 27, Freetown; 28, Lakeville; 30, Middleboro; 33, Plympton; 32, Kingston; 34, Halifax; 35, Bridgewater; 36, Raynham; 37, Taunton; 39, Dighton; 40, Rehoboth; 41, Seekonk; 42, Providence; 43, Attleboro; 45, Norfolk; 46, Mansfield; 50, E. Bridgewater; 51, Pembroke; 52, Duxbury; 53, Marshfield; 56, Hanover; 57, Scituate; 64, Sharon; 65, Foxboro; 68, Bellingham; 70, Woonsocket, R. I.; 81, Dedham; 82, Canton; 86, Newton.

SELECTIONS FROM A NOTE BOOK OF MANASSEH CUTLER, ENTITLED "A DESCRIPTION OF THE ANIMALS IN NORTH AMERICA TAKEN FROM ACTUAL OBSERVATION."

MANASSEH Cutler was a man of many parts; clergyman, doctor, politician, pioneer and naturalist. Aside from Josselyn, whose quaint writings on the flora and fauna of New England were printed a century before Cutler's time, and which can hardly be classed as scientific work, Cutler was the first person in this region to give serious attention to the natural objects about him and the first to attempt to describe systematically the plants of New England; the results of his observations being printed in the first volume of the Memoirs of the American Academy of Arts and Sciences, where some three hundred and fifty species of "indigenous vegetables" are described.

Cutler made copious notes of the plants of this part of the county and several manuscript volumes of these notes are in possession of Harvard College. In addition, he recorded his observations on the fauna of the region as it came under his notice and one such volume is in possession of the Essex Institute. These notes may not be of any special scientific value or record any observations not already known to the zoölogists of New England, from a historical point of view. However, they do possess a certain interest as showing the lack of knowledge at the time they were made, in 1786, and that such facts as are recorded

were then of enough novelty to make it worth the while to record them. And there may, too, be some facts noted which bear upon the abundance or scarcity of certain species in those days as compared with the present time. It is thought that the selections from the notes here printed do not duplicate any of the material published in the admirable Life, Journals and Correspondence of Manasseh Cutler by Wm. P. Cutler and Julia P. Cutler issued in 1888. — EDITOR.]

A description of the animals in North America taken from actual observation by Manasseh Cutler, 1786.

Humming-Bird, June 10, '86.
Sparrow, Aug. 30.
Snow Flea, Jan. 2, 1787.
Nuthatch, Jan. 7.
Speckled Wood-pecker, Jan. 7.
Cod-Fish, Jan. 26.
Brown Rabbit, Jan. 31.
House Mouse, Feb. 27.
Speckled Owl.
Speckled Lizard, Apr.
Large Spotted Owl, Jan.
Gray Squirrel, April.
Red Squirrel, Apr.
Small Teal, Apr. 20.
Long-billed Snipe or Wood-Cock, Apr. 24.
Blue Bird, Apr. 24.
Wood Sparrow, Apr. 24.
Yellow Crown, Apr. 24.
Tom-teet, Apr. 24.
Crow Blackbird, Apr. 24.
Red-winged Blackbird, May 11.
Black Martin, May 14.
Woodcock, May 15.
Spoak, May 15.
Yellow Bird, May 15.
Old England or Golden Robin, May 16.
Cat Bird, May 16.
Cheeweeh, May 16.
White back Wood Pecker, May 28.
Killdee.
Moth, June 6.
Red Perch, May 27.
Fresh Water Pout, May 29.
Small Gull, May 7, 1791.
Ox Eye.
Small Brown Marsh bird, May 7.
Sea Rock Bird, May 7.
Sea Anemone, July 7.
Wood Duck, Aug. 17.
Pickerel, Aug. 29.
Night Hawk, May 7.
Sparrow, Sept.
Scolopax lapponica.
Azure coloured Dipper, Sep. 23.
Red Squirrel, Jan., 1792.
Winter bird, Jan. 9.
Black Headed Snow Bird, Jan. 9, 1793.
Mink, April 12, '94.
Coot, Sept. 24.
Lanius excubitor.
Vegetable Insect.

HUMMING BIRD. *Trochilus colubris* (?). 1786, June 10. On examining y^e^ visceræ I was surprized to find y^e^ heart so large as to be nearly equal in bulk to all y^e^ other visceræ. The hepatic gland was large in proportion to y^e^ body of y^e^ animal. The intestines were remarkably short. The gizzard contained a number of very small insects, partly disolved, y^e^ wings of which remained entire and appeared like those of misquetters. There were some extremely small seeds & a number of shinning particles, of a bright yellow, very minute, & as hard as stones, somewhat resembling ising-glass.

This bird flew into y^e^ house at a window, & was caught alive. The greatest pains were taken to preserve it alive. It was put into a small open-worked basket, but sufficiently large for y^e^ bird. It fluttered violently, for some time, from side to side, when it appeared to be languishing & was taken out & set at liberty in y^e^ room, but it soon died, living only three hours after it was taken.

SNOW FLEA. *Podura nivalis*. 1787, Jan. 22. They frequently appear in the winter on the top of y^e^ snow, when y^e^ wind comes southerdly & snow gives, after a cold turn. Large spots will sometimes be black with them. They are commonly very sprightly. In woodland they abound most, but are often in y^e^ high ways, in great multitudes. They appear all at once, generally a little before noon, & disappear towards night — are rarely seen for more than one or two days — sometimes appear on very cold days. I have sometimes seen them in great numbers on banks of snow 6 or 8 feet deep, appearing suddenly about 10 or 11 o'clock & before night totally disappeared. The common people say they portend a thaw, & that y^e^ snow is going away, but it is not always the case. I have never known them produce y^e^ least sensation by biting, when continued ever so long on y^e^ naked legs, & conclude they do not

infest or receive their nourishment from any living animal, which is another reason for supposing they have no proboscis.

Cod-fish. 1787, Jan. 26. The generic characters correspond, but there is not an equal correspondence in y^e^ specific. May there not be a difference between the European & American? The fish from which the following characters were taken was caught in Ipswich Bay, about three leagues from y^e^ shore. It weighs with y^e^ entrails 35 pounds. It differs from the *Gadus barbatus* in not having distinguishable points on the lower jaw. The length of y^e^ body of this, and in general, is much more than three times its breadth. The first pinna of the *anus* is rather cartilaginous than bony. The cirrus is under the chin.

Crow Black-bird.[1] April 24, 1787. These blackbirds go in flocks in spring & Autumn — but are scatted about among y^e^ bushes in swamps, pond holes, & on streams of water during y^e^ summer, where they build y^r^ nests and rare y^r^ young. They are among y^e^ first birds that appear in y^e^ spring, & are often seen in midst of winter, in warm thawy weather in swamps, & about ponds. I once saw a considerable number of them in January, in company with a number of Robins on y^e^ south side of Gravelly & round ponds. It was a mild, thawy day, tho'

[1] Mr. Abbott says "Grackles early attracted the attention of the settlers in this country, not only because of their great number, but from an unfortunate habit which they then had of eating too much corn." The bird must have been much more abundant in Mr. Cutler's time than now, as writers of that time mention seeing them in great numbers and from Peter Kalm the Swedish naturalist who travelled in this country in 1748–51, we learn that a bounty was placed upon their heads and they were nearly exterminated. Later a worm made its appearance in the country and the people decided it was because of the destruction of the black-birds, and the war against them ceased.

It has since been found that they are very useful in the destruction of insects, as an examination of the contents of their stomachs proves, and they have ceased to be an annoyance to the farmer, except perhaps in the West, where they still injure the corn in the manner described by Mr. Cutler.— M. W. B.

y^e^ ground was mostly covered with snow. The winter had been very cold & severe, there was at this time a thaw, and y^e^ weather next day became very cold, & was afterwards very severe, with large quantities of snow. Near y^e^ places where I saw them were considerable Ledges of rocks, but y^e^ birds were among low bushes near y^e^ water & sang very merrily. When they congregate they are continually singing — they have a variety of notes, & make use of different notes when they sing together on trees than what they use when on y^e^ wing. A large flock on trees is excessive noisy, use a variety of notes, some very shrill, others grum like base; & it has often been observed by good judges that their notes, tho' so various & numerous, always make perfect cords.

They are exceedingly injurious to Indian corn. In y^e^ spring, when y^e^ young spines are just without y^e^ ground, they pull y^m^ up with their bills for y^e^ sake of y^e^ kernal at y^e^ roots, but they are vastly more distructive in autumn, when y^e^ corn is just out of y^e^ milk or become nearly ripe. Large flocks repair to fields after y^e^ upper stalks are cut, and sometimes before, in such numbers as to give y^e^ field a black appearance when they have settled down upon y^e^ corn. And there being, perhaps, 3 or 4 to an ear of corn, y^e^ husks are soon stripped into threads, and y^e^ corn plucked in part, and w^t^ they leave is spoiled by admitting wet & moisture which occasions mould. A field is sometimes almost ruined in a few hours. They are commonly shy when a person approaches them, & even firing at them in y^e^ field is to little purpose. The most effectual method to preserve fields, is to find y^e^ place where they retreat to roost at night, which is always in swamps & near water, commonly among thick alders. They collect in immense numbers from all quarters, for several miles distance, & place themselves in a very compact manner for their

nightly repose. The place being found a large number go into the bushes among them some time in the night, with guns, & discharge them as fast as they can load & fire, untill y^e^ whole flock is routed. The guns put them in y^e^ utmost confusion, & with an hedious noise occasioned by y^e^ notes of y^r^ wings among y^e^ bushes, like that of a rushing tempest, they rise from their beds in a body & make a precipitate flight many miles distant, & return no more for y^e^ season. After a successful Blackbird experdition, a sing bird is scarcely seen for miles around their roosting place during the remainder of autumn. The *red-wing Black-bird* sometimes associate with the *Crow black-birds*, especially in corn thieving.

Red-winged Blackbird. *Oriolus phœniceus*. May 11, 1787. In rainy weather y^e^ red does not appear so plainly on y^e^ wings, but they have a lightish yellow appearance. I think it is y^e^ same in very hot weather, owing to its being concealed by y^e^ feathers of y^e^ body just above y^e^ insertion of y^e^ wings, which are preaty long, falling over them. In a stormy day observed a large number, & was near them, which I was ready to take for another species, as I could see nothing of y^e^ red, but only a small yellowish spot, whether they were on the wing or sitting on trees — at length I killed one, which is y^e^ specimen I am now describing, & found the red had been concealed as above. I also killed his mate at y^e^ same time.

Black Martin. *Hirundo purpurea*. May 14. 1787. The specimen from which this discription is taken was found under a martin's house in my garden near y^e^ close of a long N. E. storm, in which much rain had fallen. It appeared to be in a dying state. I brought it into y^e^ house — the next morning it was dead. Whether y^e^ severity of y^e^ storm or some disorder was the cause of

its death I am uncertain. It had a great number of very large fleas. Their form different from y^e^ common house-flea, & they leap not so far nor their motions so agile.

These martins are new visitors in y^e^ northern states — they came from y^e^ southward & y^e^ progress has been gradual & easily marked. Generally advancing several miles annually. In 1765 they were plenty at New Haven — & about that time arrived as far as Hartford in Connecticut. But they were from that time to 1775 in advancing as far as this town. The first houses erected for them were in my garden, & they were not well stocked with tennants until 1783 or 84. They have now arrived at Portland, Casco bay. They build no where, to my knowledge except in y^e^ houses erected for them, & are fond of very gay habitations.

Wood Cock. *Scolopax Fedoa.* May 15, 1787. In y^e^ day time they keep about small runs of water in swamps & obscure places, where they are rarely seen. When they apprehend danger, they squat very close between bays, & in y^e^ grass, so that a person may almost get their feet upon them, being nearly of y^e^ color of y^e^ ground, before He sees them. Then take wing, & fly low to some distance, where they conceal themselves in y^e^ same manner. In y^e^ twilight of y^e^ evening they come out into open ground, — & sing with chipping note — after they have chipped, loud & distinct at y^e^ close of the note they make a croak in their throats. These notes are repeated a few times, when they rise, with a buzing or whistling noise made with their wings, much like that of a Partridge & ascend in to y^e^ air to a considerable height. After a circuitous flight for a few minutes, they return directly over y^e^ place from which they ascended, & begin their chippering note again very quick, & with this note descend perpendicularly, & settle on y^e^ ground with a few feet of y^e^ spot from whence

they rose. After chipping loudly & distinctly a few times, rise & descend again as before. These flight are continued thro' y^e^ first of y^e^ evening, and perhaps y^e^ night. By observing y^e^ place from whence they rise, & after they are goine up it [is] ease take a stand near the spot, & to shoot them after they descend, especially in y^e^ first of y^e^ twilight, before it is too dark to distinguish them.

Ox-Eye. *Charadrius* [now *Squatarola.*] In abundance on all our sandy beaches— remarkable for running— for they never walk. In running y^e^ legs are moved with surprizing agility & quickness — sometimes even on y^e^ edge of y^e^ surf — but frequently wander about single on high sandy beaches — they have a sort of peeping note — not noisy — rarely use their note except when pursued, & just as they take wing — they do not seem much inclined to collect in flocks. I believe some people call them *peeps.* They are remarkably fat at all seasons & well tasted, except a little fishy.

This spec^n^ killed at Beach at Nauhaunt.

June 13, 1795. In a sand hill on y^e^ great Beach in Ipswich, I observed several holes, which entered in an horizontal direction. Passing my cane into one of them I introduced nearly y^e^ whole length, but did not perceive y^e^ end. As I took it out a small swallow flew from another hole about 4 feet distant, & instantly another came out of hole into which I had introduced my cane. The wind being very high, & their flight quick I was unable to observe, with any exactness, their colour or size. I think their bellies were whitish & their size much less than y^e^ barn swallow. This is y^e^ first positive evidence I have had of Swallows entering those holes.