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CLASSES IN THE SEVERAL DEPARTMENTS FOR 1879,

WITH THE DATES AT WHICH REPORTS ARE DUE.

FIRST DEPARTMENT — *Physical Science and the Arts.*

First Class — Physics and Astronomy, April 29, 1879: Irving Magee, D.D., Lewis Boss, Thurlow Weed Barnes, Reuben H. Bingham, Martin L. Deyo, Joseph Gavit, Ernest J. Miller, Henry R. Pierson, LL.D., John F. Seman ,Philip Ten Eyck, J. Hampden Wood.

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Third Class — Arts, Oct. 28, 1879: Orlando Meads, Robert H. Pruyn, LL.D., Isaac Battin, Willard Bellows, Philander Deming, Wm. G. Dey Ermand, Walter Dickson, George Doelker, Hiram Ferguson, Dexter Hunter, George R. Meneely, Lansing Merchant, Samuel L. Munson, Erastus D. Palmer, Nathan B. Perry, Joel R. Ransom, Benjamin R. Spelman, Charles Van Benthuysen, William T. Valentine, Maurice E. Viele.

SECOND DEPARTMENT — *Natural History.*

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Second Class — Botany, June 10, 1879: Charles H. Peck, Alfred F. Chatfield, Horace M. Paine, M.D., Henry H. Martin, Henry S. McCall, De Azro A. Nichols, George R. Howell, Erastus Corning.

Third Class — Zoology, Nov. 11, 1879: J. A. Lintner, George T. Stevens, M.D., Wm. W. Hill, John V. Lansing, M.D., Edward R. Hun, M.D., William Hailes, Jr., M.D., Erastus Corning, Jr., Ira B. Sampson.

THIRD DEPARTMENT — *History and General Literature.*

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Second Class — Ancient History and Archæology, June 24, 1879: Henry A. Homes, LL.D., Joel Munsell, David A. Thompson, J. Livingston Reese, D.D., Daniel J. Pratt.

Third Class — General Literature, Nov. 25, 1879: Leonard Kip, Paul F. Cooper, John McC. Holmes, D.D., Alfred B. Street, William A. Young, Hiram E. Sickels, Chauncey P. Williams, Charles E. Smith.

Fourth Class — Political and Social Science, Oct. 14, 1879: Isaac Edwards, LL.D., Duncan Campbell, Charles S. Hoyt, M.D., Gilbert M. Tucker, Lemon Thomson, John W. McNamara, James O. Fanning.

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TRANSACTIONS.

THE MECHANICAL ACTION OF RADIATION.

By LeRoy C. Cooley, Ph.D.

[Read before the Albany Institute, February 1, 1876.]

The motion of light bodies under the influence of radiant heat and light seems to have been noticed, independently, by several observers, at long intervals during the last half century, but only within the half decade just past can it be said to have gained a place among the phenomena of acknowledged interest in science.

In the *Edinburgh New Philosophical Magazine* for 1828 is a record of what seems to have been the earliest experiments on this subject. They were made by Mr. Mark Watt, and I quote from his interesting paper the following description of the first instance of a light body indicating, by its motion, the impression it received from the sun's rays. "Twelve or fifteen magnetized sewing needles were stuck into a thin circular slice of cork an inch in diameter, at a distance of one-sixth of an inch from each other. The heads of the needles were so fixed into the piece of cork that they stood perpendicularly and all the points, being south poles, stood uppermost. The cork was then placed on the center of a surface of water $1\frac{1}{2}$ feet in diameter. The needles, in this situation, being prevented from evincing any polar attraction by their perpendicular position, were attracted by a moderate degree of light, heat or electricity, but were repelled by the more powerful impulses imparted by the concentration of any of these bodies."

After the lapse of twenty years the phenomenon seems to have been rediscovered by Mr. Mitchel. A description of his experiment may be found in the first chapter of *Dick's Practical Astronomer* (see also *Scientific American*, vol. XXXIII, 9) and reads very much as follows:

A plate of very thin copper, an inch square, was fixed upon the end of a fine wire ten inches long. A very delicate magnet was fastened to the middle of the wire and the whole, balanced on a pivot, was enclosed in a glass case. The rays of the sun, collected by a concave mirror of two feet diameter were thrown to a focus on the copper plate. The plate began to move under the influence of the condensed sunbeam and in about two seconds it had traversed as many inches and struck against the side of the box. This experiment was made with a view to prove that "Light, though exceedingly minute, has a certain degree of force momentum."

Many years later, it was in 1863, the energy of radiation seems to have revealed itself anew to the eminent Prof. Joule. "By means of a cylindrical glass vessel, divided in a vertical direction by a blackened pasteboard diaphragm, which extended to within one inch of the cover and of the bottom of the vessel, and in the upper of which spaces was delicately suspended a magnetized sewing needle furnished with a glass index, he was able to detect the heat from a pint of water heated to 30° C., placed in a pan at nine feet distance; also that of a moonbeam admitted through an opening in a shutter as it passed across his apparatus." This description is extracted from a lecture by the Earl of Rosse on the heat of the moon, given at the Royal Institution in May, 1873.

In April, 1873, ignorant of all these earlier observations, I read, in this room, a paper on "Convection applied to the Detection of Heat," showing that a delicately suspended needle would move in obedience to slight changes of temperature in any body brought into its vicinity, and describing a *Thermoscope*, quite sensitive, acting on this principle (*Journal Frank. Inst.*, vol. LXVI, 343). Further experiment soon afterward resulted in the construction of an instrument so sensitive that the needle would swing in response to the heat radiated from the face of a person sitting at a distance of thirty feet (*Jour. Frank. Inst.*, vol. LXVII, 408). The form of instrument finally adopted, and used also in experiments to be described in the sequel, may be briefly described as follows. In a chamber whose walls are, to a considerable degree, impervious to heat, a glass thread, very long and very light, is suspended horizontally by means of two parallel silk fibres eighteen inches in length. One end of this slender needle carries a small vertical disk of paper. The small end of a conical metallic reflector passes through the wall of the chamber and its opening is covered with a piece of thin partially charred paper. The radiations from any distant source of heat are concentrated upon this scorched paper by the reflector. The needle-disk is on a level with the lower part of this paper and moves toward or from it under the influence of every change of temperature it experiences, approaching if it be warmed and receding if it be very gently cooled, but approaching when the reduction of temperature is considerable.

In the meantime Dr. William Crookes, "while weighing heavy pieces of glass apparatus in a chemical balance enclosed in an iron case from which air could be exhausted," noticed that "when the substance weighed was of a temperature higher than that of the surrounding air and the weights, there appeared to be a variation of the force of gravitation." His first paper was sent to the Royal Society in May, 1873. "Experiments were thereupon instituted with a view to make the action more sensible and to eliminate sources of error."

By ingeniously devised apparatus Dr. Crookes was able to subject light bodies to the action of radiant heat and light in a vacuum perfect, doubtless, beyond precedent. While the exhaustion proceeded he found the motion of his slender balance beam to be toward the source of heat, until, a very high degree having been attained, the motion *turned the other way*, the light body receded from the source of radiation as if driven by a delicate repulsion. (See *Quarterly Journal of Science*, 1875.) His second paper communicated to the Royal Society the interesting discovery of the mechanical effect of radiation in a vacuum, and *Repulsion by Radiation* is a phrase describing a new-found fact in physical science for which we are indebted to this capital research of Dr. Crookes.

These experiments of the English scientist, pronounced, by the President of the Mathematical and Physical Section of the British Association, to be among the most interesting in the whole range of physical science, have attracted much attention to the phenomena. Prof. Dewar in Scotland and Herr Neesen in Germany have made valuable additions to the experimental data.

Prof. Dewar employed a novel means of obtaining the necessary vacuum. When the pump refused to reduce the tension of the rarefied gas, the residue was removed and the vacuum perfected by the absorbent power of charcoal. The vacuum thus obtained, like that of Mr. Crookes, forbade the passage of the induction spark, and so sensitive was his instrument that "an ordinary lucifer-match held at a distance of four feet produced instant action, which was observed by means of a telescope." (*Nature*, XII, 217.) Of his results more is to be said as we proceed. Herr

Neesen's apparatus consisted of a rectangular case of sheet iron with an aperture in one side closed by a glass plate near to which hung a small and delicately suspended mirror. The radiations were received by the glass plate, through which they passed to fall upon the mirror beyond, and the mirror was compelled to turn in obedience to their influence. (*Nature*, XIII, 10.)

By the experiments of these several observers it is well established that very light and mobile bodies are affected quite differently by radiant heat or light according as they are suspended in air or in vacuo. *Attraction* in air and *repulsion* in vacuo are the terms employed by Mr. Crookes to describe these effects. These terms are convenient, but unobjectionable only when we use them to indicate the *direction* of the motion and not to describe the nature of the forces acting to produce it.

Of the nature of these forces views are not yet in accord. Mr. Crookes considers the air-current theory as altogether incompetent to account either for the attraction or the repulsion, but awaits the accumulation of all the facts before attempting to explain any of them. Prof. Dewar regards the *heating of the movable disk* as the cause of the motion. He is reported as saying that "While the action takes place in air of ordinary density it is probably due to air currents" but, from the report, he seems not to have based this opinion upon any direct experimental proof. Nor does he allow the repulsion in vacuo to be due to any new force of repulsion: he attempts to refer it to the molecular energy of the minute residuum of gas still left in the most perfect attainable vacuum. "What takes place," he says, "is this, the particles are flying in all directions with velocity depending upon the temperature. When they impinge against the heated disk their velocity is increased. They go off with a greater velocity than those which go off from the colder side and hence there is a recoil of the disk." And this recoil he thinks competent to put the disk in motion even in his excellent vacuum "where we know that the exhaustion has reduced the density to $\frac{1}{4000000}$ of its original."

Prof. Osborne Reynolds claims that whenever a surface imparts heat to a gas, there must be a reaction of the gas against the surface. A surface free to move would be propelled by this reaction. Moreover in a vacuum this motion would encounter less resistance and hence would be more conspicuous, as if it were due to a stronger force. Repulsion in vacuo, according to this view, is the effect of this gaseous reaction. (*Nature*, vol. XII, 405.)

If others have engaged in the investigation of this interesting subject, their work has, down to the present time, escaped my attention.

In July, 1875, I read a paper before the *Poughkeepsie Society of Natural Science* giving a synopsis of several series of experiments some of which were made before the publication of Mr. Crookes' remarkable discovery, but many of them afterward, with a view to determine the nature of the force as far as the so called attraction in air is concerned (*Jour. Frank Inst.*, vol. LXX, 134). The points then made are these: 1st. The motion of the needle having proved to be, under a great variety of conditions, exactly what air-currents are competent to produce, we may justly infer that it is due to convection. 2d. If this motion shall cease to occur when the air is removed (and Mr. Crookes has proved that it does), the evidence in favor of convection is complete.

Whatever may be the nature of the repulsion in vacuo, convection will, doubtless, in the end, be admitted to be the cause of the motion in air. The two motions are, I am persuaded, altogether distinct phenomena manifestations of two antagonistic forces, the repulsive being the more delicate and able to produce its effect only when the overwhelming power of convection currents is overcome by perfecting the vacuum.

But there is another phase of this curious action which seems to have escaped the notice of former observers. It may be described as *repulsion in air.* The application of a very gentle heat will, under certain conditions, drive the disk away from the warmed surface, even in air of ordinary density.

At intervals, from the time of my earliest experiments, this puzzling motion would thrust itself before me until I was convinced that it was not an experimental accident but that it was a legitimate effect of some rare combination of conditions. What these conditions are I set myself to discover.

It was an effect which I could not, at first, produce at will. Sometimes it would appear in the early morning but refuse to be reproduced as the day advanced. Sometimes it would occur in the evening when no trace of it had been seen during the day. A day of alternate showers and sunshine seemed to be most favorable to its production. Remembering that the walls of the chamber were to a considerable degree impervious to heat so that the temperature within suffered no rapid changes as did that without, these facts suggested the direction in which to seek for the cause of the action. By inserting a thermometer into the chamber and placing another outside, the difference of temperature between the interior of the instrument and the air outside could be measured and its relation to the motion of the needle could be studied. A multitude of observations followed. In every case when the repulsion occurred the temperature of the interior of the chamber was found to be higher than that of the external air. With a difference of a single degree (F.) the needle would be repelled by the gentle heat of the hand held at a distance of twelve inches, while by a somewhat stronger heat the motion would be reversed. With a larger difference of temperature the repulsion would respond to a greater heat, becoming attraction again, however, if a certain limit of intensity was passed. Such observations finally revealed the necessary conditions. Repulsion in air occurs when : 1st. The temperature of the interior of the instrument has been for some time a little higher than that of the external air ; and 2d. The degree of heat applied is appropriate to this difference of temperature.

The next step was to carefully determine the place of the zero of the needle scale. Call to mind the arrangement. The slender needle is suspended horizontally by two parallel silk fibres. The torsion of these fibres is a delicate force tending to hold the needle in a certain position. The place of the disk thus held at rest is the zero of the scale. Now the swinging of the needle toward the zero can indicate no positive action of any force other than the torsion of the fibres. Its swinging away from zero, however, can be due to nothing less than some positive force which overcomes the torsion. Having determined the place of the zero, repeated observation showed that the repulsion was real, since the needle moved beyond its zero in opposition to the torsion of its fibres.

In explanation of this curious effect I offer the following suggestions. It is well known that a cooled surface will cause a downward air-current in contact with it, and again that heat being applied will reverse the direction of this current. But this reversal cannot be affected instantaneously. The effect of a *gentle* heat will be 1st, to *slowly* neutralize the cold and thus *gradually* diminish the downward current and 2d, afterward to produce, as gradually, a current upward. Now while the cold current is being neutralized, the torsion of the fibres will carry the disk to its zero and when the upward current is established the disk will be again wafted toward the warmed surface.

But if this transition from a downward to an upward current is very slow there must be an appreciable time when there is equilibrium, when the air is in contact with a surface warmer than itself and yet for a brief period is free from convection currents.

Again it is well known that the air is perfectly elastic and further that an elastic body will transmit the energy of blows which do not put its mass in motion. Then let us conceive a mass of air, lying between the disk and the surface which receives the heat, subjected on the surface side to a temperature higher than its own and yet free from convection currents. Under these conditions the elastic medium must transmit the heat energy to the disk in a manner not altogether unlike the transmission of the force of a blow by a series of elastic balls. As I conceive the molecular motion it is this. The molecules of air are in motion with a velocity depending upon temperature. When they impinge against the warmed surface they are thrown off with an increased velocity. This velocity is transmitted until the molecules in contact with the disk receive it and they strike the disk with greater energy than do those against the opposite side. This excess of energy drives the disk along.

If this explanation be correct then while the attraction in air is the manifestation of the well known convection currents, this repulsion in air is the manifestation of *a molecular transmission of energy* by the air in straight lines outward from a heated surface. Now if such a molecular action do exist then a light body near a heated surface must, in every case, be subject to the influence of these antagonistic forces, being solicited toward the heat by convection, and repelled from it by the energy transmitted. Because convection is the more powerful, the motion is toward the source of radiation except when by careful choice of conditions the delicate repulsion can be made visible.

Whether this repulsion in air is at all related to the repulsion in vacuo, I am not prepared to consider clear. The effect of exhaustion, on the relative strength of these two forces, is, however, an interesting point in this con nection. In a good vacuum the power of convection must be vastly reduced and as the vacuum approaches perfection, this power must approach annihilation. On the other hand nothing short of an absolute vacuum can forbid the molecular transmission of energy. It seems highly probable that at a certain high degree of exhaustion this molecular energy would be the more powerful of the two, and hence that repulsion would be the normal instead of the exceptional indication of the instrument.

THE WINTER FAUNA OF MOUNT MARCY.

By Verplanck Colvin.

[Read before the Albany Institute at the Annual Meeting, Jan. 4, 1876.]

The fauna of an elevated mountain district is usually more or less peculiar and different from that of the surrounding lowlands, and the rule seems to hold that with increase of altitude and decrease of temperature a hardier and more boreal vegetation will be found, accompanied with animals common to colder and more northern regions. It is not so generally understood that the fauna peculiar to a given mountain section in summer often changes considerably at the approach of winter, many of the forest or mountain habitants departing to more hospitable regions. Not alone the migratory birds who flutter with fashionable elegance from the Adirondacks to Florida at the first rude blast of winter — having only as their home the free air, which is everywhere — but the less favored forest-dwellers, beasts of prey and beasts that are preyed upon, two great natural divisions of animated nature not used in technical classification, which, having no wings to bear them away, are fain to stay and take their chance to devour or to be devoured.

Those who have a knowledge of the wilderness are aware that however wild a region may be, and however abundant the game, it is rare that any but the most skilful and stealthy hunter catches even a momentary glimpse of the creatures of the woods. In fact thorough foresters readily detect the novice in woodcraft by his invariably expecting, upon entering the wilderness, to behold abundance of game — beasts and birds — in sylvan simplicity, unwarily parading themselves upon his view. The mere civilian, after exhausting marches through silent solitudes, generally returns half in doubt whether he has really visited the region of his fancies and day dreams — whether living thing really dwells in that region through which he has been conducted. Nevertheless the only fault lies in his dreams, as the region of his fancy has no existence. Had he the skill of the still hunter, the crushed leaf, the twigs browsed by deer, the scratched tree bark, the broken branch, the trampled grass, the muddied water of stream, and footprints only visible and interpretable to the eye of skill, would have revealed a wonderful variety of life: telling the secrets of their modes of living, their food, their homes, pursuits, and their pursuers. It is easily seen that the accurate study of the habits of wild animals, undisturbed in their native haunts, is a study in which the man of science, unless skilled as a hunter, is at a discount. The true book of wild life is the open volume of tracks and trails spread over the whole wilderness and far more difficult than Greek to savans. This volume has written upon its broad pages the daily journal of savage society, telling of their deeds uninfluenced by human presence, the outgrowth of natural instincts. The nocturnal habits also of most of our wild animals, which, like the owl, sleep by day, and prowl by night, render it still more difficult to secure observations of their ways of life.

The summer woods give to us no such plainly written pages of this history as the winter's snow affords, for now though the night be dark, let there but be soft snow, and the footprints stand as records, plain as day. It is to some readings of these records in the snow, had this winter upon the slopes and summit of Mount Marcy, that I desire to call your attention.

Mount Marcy, or Ta-ha-wus (interpreted, "I cleave the clouds"), as it is said to have been called by the Indians, is unquestionably the highest of our mountains — over 5,400 feet in altitude above the sea. It rises sharply upward, a solid mass of rock, while huge ridges, each one a mountain, trending in different directions from its summit, support the central mass like giant buttresses. The summit is often lost amid, or soars above the clouds, and its slopes — below the bare, desolate, alpine crest of rock — are densely covered with a stunted evergreen forest, rooted amid the crevices, the trees increasing in size and vigor as the altitude decreases. The deep valleys, descending between the mountain crests one and two thousand feet, thickly forest-covered on their slopes; the irregular plateau-like valleys north and south, and the little mossy nooks of level land upon its sides, are the haunts of its wild inhabitants, the fauna of the coldest, the most alpine, and most desert portion of our territory.

Huge mountains tower upon every side, like captains encircling their chief. Whiteface far away, MacIntyre less distant, Mt. Clinton and Mt. Wright, Mt. Haystack and Mt. Skylight, Mt. Colden and the Gothics, and far in the east Mt. Dix, the Giant, and Macomb, and numberless others — the landmarks of the Adirondacks — show themselves.

This is a wild place for any living thing; let us see what creatures make their home here.

It is evident that he who is so fortunate as to first read the footprint writing on the snows of the slopes of Marcy, holds the key to a history of its fauna, and at the same time is permitted to be the first to ascertain the effects of the rigorous mountain climate upon the habits of the different species, as far as his observations go. The study of trails enables him to ascertain the approximate altitudes at which certain of our wild animals exist, and, in turn, by a careful classification of animals, he is enabled to show that within zones of different altitudes are found associated animals which belong to similar zones of cold, in higher latitudes. The flora of the Adirondack peaks has been studied; of the fauna of these mountain summits this is thought to be the first publication.

It may be mentioned that my presence among the mountains in the early portion of this winter, was occasioned by the work of the Adirondack survey, under the authority of the State, for which work appropriations had been made by the last Legislature, and that the constant duties of the survey permitted only the taking of natural history notes of such matters as came unsought before me. This paper, therefore, is only intended as a brief contribution to the winter history of our mountain fauna — preferable, perhaps, to a mere list of the species observed, which was all that I originally intended to present.

Winter may almost be said to have a perpetual lease of Mt. Marcy. It is true that about the beginning of July, he finds his banks of snow badly broken by the sun's inroads — beyond his power to remedy — and so takes himself away to his cooler resort, gliding away to the south pole, which now demands his entire energies; but scarce two months will have elapsed before he will be back again.

If snow be the criterion, Mount Marcy has barely two true months of summer. The summit is often whitened with it as late as the beginning of July, and the first of September rarely passes without a premonitory, though temporary, covering of the crest with snow. It is safe to assume that the climatic winter of the summit commences at the latter portion of September or about the first of October, and ends in June.

Besides mentioning the different species, the presence of which have been determined, I shall call your attention briefly to the principal absentees — animals which once were or are now found in this locality in summer, but which were obviously absent during our stay, though with few exceptions, still met with in the warmer lowlands.

Studying the fauna in this manner, we find among the most important of the animals which have left a record of their presence by footprints in the snow — the panther, the *Felis concolor* of naturalists. This animal, the painter of the guides, the largest and most powerful of our Felidæ, is entirely carnivorous — an Ishmaelite among beasts. Immensely muscular, it is yet more remarkable for agility and swiftness of movement, and finds no difficulty in providing itself with game food. In the notch between Mt. Marcy and Mt. Skylight one of the guides came upon large foot prints in partially thawed snow, and following them up the slopes of Mt. Marcy, through the dense, low timber, now ascending steeps, now traveling along snowy ridges, found in several places clear and unmistakable impressions, large, massive footprints of this mountain lion.

To myself the trail of this animal was far from unexpected. For years I had, summer after summer, remarked indications of their presence along the Opalescent river valley, and on the neighboring mountains, and less markedly, in the Panther gorge, once its undisturbed resort and home, for the *chat de montagne*, is here, as in Canada and the west, found true to its name, rendering it, veritably, the cat of the mountain. It is with regret that I must record that in the present instance his trail appeared to indicate that he was in the ignoble pursuit of rabbits! This could not be owing to necessity either, for deer in plenty were to be had in the valleys to the southward, and from indications observed during the summer, were not only frequently destroyed by panthers, but devoured with more haste than delicacy — flesh, hair, entrails and skin being greedily eaten together. It may be here remarked that in accordance with the opinion of some of the guides, the panther, like others of our wild animals, is quite local in its habitation, the guides telling of one having a large and well marked footprint, which for four or five years has resided upon a small mountain homestead of about twenty-five square miles, always returning after his occasional progresses to his more distant dominions. These long direct journeys are also a strongly marked peculiarity of the panther. In the love of locality the panther shows a similarity to the common cat — *Felis domestica* — and leads us to surmise whether the strange affection which the latter creature exhibits for home rather than an individual, is not the great, unextinguished wild trait of its character. Indications of the panther were also met with near Lake Tear-of-the-Clouds, and other guides reported tracks seen near the Boreas. Where the exact habitation of this particular panther was we were unable to determine. Our advent must have annoyed him, for his trail was seen no more. Whether in the dark recesses among the rocks it found a home, or in some sunny glade with southern exposure, all sheltered from chilly northern gales with dense evergreens, we do not know.

Next in importance to the panther in the list of species the trails of which were observed, is the gray or Canada lynx, the *peeshoo* or loup-cervier of the Indians — *Lyncus borealis* of De Kay, *Felis canadensis* of Richardson. Its large, bold footprints were observed on the southern slopes of Mount Marcy, and in the vicinity of little Lake Tear. Like the panther, it was also rabbit hunting, its footprints being visible superimposed upon those of its game, in the little paths which they had beaten in the snow. This large and apparently powerful animal, by some woodmen erroneously called cat-a-mount, owes its imposing appearance to its heavy, dense covering of fur; and when deprived of its skin is so much reduced in size as to seem almost like another animal, the body looking much smaller, though the limbs and paws maintain the aspect of great strength. It is also entirely carnivorous, yet it is said by some to be good eating, its flesh resembling that of the rabbit. The flesh of any animal so purely carnivorous, cannot, however, be considered fit food for man. Its usual residence is in the dense lowland swamps, and its presence at the altitude of over four thousand three hundred feet in the gorges of the mountains indicates that it is not the swamps, but their inhabitants — the rabbit — that he desires. The trapping by a guide of two of these creatures near Elk lake, where the trail leaves it for Mount Marcy, seems to refute in some degree the opinion advanced by De Kay that it has no repugnance to water. The shallow and narrow outlet of the lake is nearly spanned at one point by a fallen tree which was selected by a pair of lynx as a bridge. A trap being set midway upon the log, one of the creatures was captured, after which occurrence, unwarned by the fate of its companion, which could easily have been avoided if it had stepped through the shallow water, the other lynx, following the same path, planted its foot also in the trap. This is an animal which we might expect in a high, cold region, for to its general distribution throughout British America even to the shore of the Arctic sea, it owes its well earned title of *Canadian*. It is not recorded as having been met with in the State more than about one degree to the south of Mount Marcy.

One morning, this winter, as we ascended the steep slopes of Mount Skylight through the deep, freshly fallen snow, a dog belonging to one of the guides broke away fiercely upon a fresh trail, and filling the woods with his eager cry, combined into irregular echoing melody by the surrounding mountains, coursed his game to and fro, under the ledges and along the mountain sides to the steeper slopes of Marcy. An inspection of the trail showed the footprints of a black cat — the *Mustela canadensis* the animal often improperly known as the fisher — improperly because he is not a fisher, as it seldom eats other fish than those which it is able to steal from an angler. The footprints of this animal were frequently met with at different times and in different places upon Mount Marcy, the trail indicating animals different in size and age, so that it is probable that a number of these creatures make this vicinity their home. A carnivorous animal, agile and powerful withal, it was like its companion carnivora, hither come in search of rabbits, with (judging from the trail) an occasional diversion after mice, or other small game. Its inhabiting these mountain heights directly refutes the assertion that it does not frequent the same elevated regions as the martin. In one place we observed where a black-cat at play had climbed to the summit of a huge rock, and doubling his forward paws beneath him, slid downward, ploughing up the snow. When pursued by the dog they invariably took to their heels, and in long, easy leaps sped out upon the icy rocks fronting the precipitous sides of the mountain, and passed safely across the glary surface of the avalanch-swept slides. Constantly ranging, it seems to have no fixed habitation, and generally selects the night for its travel and its depredations.

The fourth of these mountain dwellers is the sable, of rich, rare fur and regal name; the *Mustella martes* of naturalists. This beautiful and rare animal, judging from the frequent tracks, is quite abundant in the forests on the side of Mount Marcy. It here occupies a region of country which owing to its elevation and coldness greatly resembles the semi-arctic portions of British America, and it is interesting to remark that no traces of it were found above the timber line on the open, barren sub-alpine portion of the mountain, in this respect maintaining the habits of their race, which — according to Hearne and Pennant, are never found in the barren lands near Behring's straits, either in America or Asia, though abundant in the scrubby forests margining the open. Thus this interesting little animal may be said to become a measure in climatology, and serves to give us as clear a conception of the relation of our mountain summits to the boreal regions of the continent, as does the better known arctic flora. Alas for the poor rabbit, as though not sufficiently persecuted, he finds in the sable an insatiable foe. Hither and thither through the dwarf forest he pursues them; or, creeping stealthily, leaps upon one and opens its life blood upon the snow.

Once this winter I came upon a spot where a sable had killed a rabbit, evidently by seizing it by the throat and opening its veins. From the scene of slaughter a deep gouge-like depression in the snow, with footprints, showed where the sable had drawn away its quarry.

Tracks of the ermine, *Putorius noveboracensis* were recognized in one place but it does not appear to be common; nor were the tracks of other weasel distinctly recognized.

And now we come to the rabbit, as it is popularly called, more properly known as the white or varying hare — *Lepus americanus.* Poor creature, it seems but created to be destroyed, yet is so abundant as to bear the inroads of its foes without apparent diminution. Timid and harmless, it seems to have the widest or most extensive range of any of the animals of North America, being found throughout nearly the whole of the British possessions from the Atlantic to the Pacific. As a true, varying hare, that is, annually changing its color, it seems to be confined to the districts of cold winters, and has everywhere the character of an inhabitant of boreal regions. The wonderful provision of nature, by which it is as well secured from observation in winter as in summer, is its most noticeable characteristic; and it is the more to be remarked, as with the exception of the ermine and weasel, it seems to be the only varying animal inhabiting the State. In 1872, in September, I captured a living specimen on the summit of Whiteface mountain at an altitude of 4,900 feet. It was then of an even fawn-brown color and showed no sign of change. Early in November, in 1873, we met with many already turned entirely white, the snow having gained a depth of from a foot to eighteen inches. One or two glimpses of them this winter served to show that they were more like scudding snow than any animated thing. Their range upon Mount Marcy does not appear to extend above five thousand feet, while upon the Rocky mountains of our great west, I met with them at an altitude of 12,000 feet above the sea, associated with the ptarmigan and coney. Here, as among the snowy peaks of Colorado, I observed that while in the cold upper regions of ice and snow the hare had changed in color to its white winter coat, in the lowlands to which the snow had not yet reached they were still brown or mottled white and brown, indicating that they do not move from their localities with the coming of winter, and that climate controls the changing of their color. It may be possible that the polar hare, *Lepus glacialis* of Leach, has a home upon our high peaks, but this is as yet undetermined.

The common red squirrel, *Sciurus hudsonicus*, we found at an altitude of about 4,000 feet, increasing in abundance with decrease of altitude. The trails indicated that it was pursued and preyed upon by the sable. This squirrel here feeds on the seeds of the black spruce.

While engaged in trigonometrical work on the marsh, at the head of Lake Tear, from which during a thaw the snow had entirely disappeared, the guide's dog, which had been digging furiously for some time in the deep peat moss, suddenly drove from its burrow a good sized animal of the rat kind, resembling in size and color the star-nosed mole. Its rapid disappearance in some other hiding place prevented more than a brief glimpse of it. There was, however, a suggestion of resemblance to one of the geomys or sand rats. In color it was dark blue or gray-black, and its length in the neighborhood of six inches. The soil in which it burrowed was (below the moss and peat) a coarse sand and fine gravel. The food of the animal is probably vegetable, the roots reached by its burrows.

Tracks of deer-mice were observed on the slopes of the mountain at all elevations not exceeding about four thousand feet; and, occasionally the minute trail of a small shrew, supposed to be the *Sorex fosteri*, or Forster's shrew. I noticed in many places where, as described by Richardson, it would leave the surface of the snow by descending some one of the little vertical tunnels left around some bough or branch or small sapling. This wonderful little animal inhabits even the desolate regions within the arctic circle, as far north as latitude 67 degrees. Richardson remarks that "The power of generating heat must be very great in this diminutive creature to preserve its slender limbs from freezing when the temperature sinks to 40 or 50 degrees below zero." If it is capable of enduring such a temperature, I am indeed surprised, as in 1872, early on a cold icy morning, on the summit of Mount Seward, the ground being covered with snow, I caught, alive, an active little specimen, which, to my surprise actually expired in my hands, apparently from cold. Nevertheless it seems if not handled to be able to survive the most severe Adirondack winters.

Of birds, but three varieties have left their footprints on the snows of Mount Marcy, the raven, the partridge (ruffled grouse) and snow birds. I never before met with a raven in the vicinity of Mount Marcy, but on my first ascent this winter as we mounted the ledges at the head of the great slide, a number of these huge birds arose, and uttering their peculiar hoarse croak, departed on slow, heavy-flapping pinions, regardless of revolver shots that followed them. The raven, therefore, is a winter habitant of Mount Marcy, leaving his footprints on the snowy ledges at 5,000 feet above the sea.

Early in last November, in one of our almost daily ascents of Mount Marcy, an eagle was noticed floating and circling with outstretched wings at about the height of the summit of the peak. It was apparently of the baldheaded variety. A large hawk — species unknown — was observed on another occasion, and one evening while we were descending from our labors, being still above the timber line, a great owl sailed past, gazing upon us with huge eyes that appeared expressive of extreme wonder.

During the second or third day of survey work upon the summit of the mountain, late in the afternoon, a shout of surprise from one of the guides caused me to look quickly to the northward, where, judge my astonishment, not over twenty or thirty rods from us a flock of six wild geese flying with wonderful velocity, came towards us, passed over and were gone. The faint, distant *honk* of the leader seeming to imply that they were bound for warmer latitudes. The wild goose is not an inhabitant of the Adirondacks, and these were evidently coming from more northern waters. This afforded, perhaps, the first opportunity of determining the height at which wild geese travel during their migrations. They seemed neither to ascend nor to descend, but kept a level course, and what is most remarkable, that course was as near the true astronomical meridian as it seems possible that a bird can fly! I would estimate the altitude of the flock in their flight at about 5,500 feet above the ocean level. It was the last place where I should have expected to have seen wild geese. A single discharge of a fowling-piece, had one been at hand, might have brought them all to the ground.

The Canada jay, *Garrulus canadensis*, was observed in the vicinity of little Lake Tear early in the winter, but with the increase of cold and snow seemed to leave the inhospitable heights, and descend to the depths of the Panther gorge. This might have been owing to the attractions of our camp, around which they fluttered in search of scraps.

A large, dark plumaged wood-pecker was noticed operating upon the spruce-trees at different points in the Panther gorge and on the slopes of the mountains, at an altitude of from 3,000 to 3,500 feet above tide. The species was not determined, but from its appearance it was supposed to be the *Picus villosus* or hairy wood-pecker.

Large flocks of the white snow bird, *Plectrophanes nivalis*, were observed upon the snows, around the summit of Mount Marcy on different days; and once or twice two or three of a more plainly marked snow bird, judged to be the Lapland (*P. lapponicus*) were noticed. A small bird, not recognized, was seen feeding upon the cones of the spruce.

In entomology but few observations were made. Insects are the creatures of the summer. Bleak snows and freezing temperatures prohibit their appearance. During the latter portion of last October, the snows on Mount Marcy half disappeared from the open mountain in consequence of a thaw. This snow had been six inches deep in the valleys, a thousand feet below the summit. At this time I noticed fluttering above the chilly rocks of the open summit, above the timber line, a few solitary insects. A small moth which I caught proved entirely unknown to our accomplished State entomologist, and was forwarded by him to Dr. A. S. Packard, Jr., for examination. Dr. Packard recognizes it as the (*Cheimatobia*), *Operhoptera boreata* found in different portions of the country, and according to the doctor, " abundantly in Alaska." I also found a beetle during this thaw crawling upon the very summit of the peak.

In the spruce forest of the Panther gorge, at the foot of the mountain, many of the trees were observed to have been attacked by insects, probably the small beetles described by the State botanist in a recent paper before this Institute (*Hylurgus rufipennis* and *Apate rufipennis* Kirby). These trees were the resort of wood-peckers, who seemed to have a most active interest in the beetles or insects, piercing the bark everywhere, in search of them, and covering the snow at the foot of the trees with the fragments of bark.

Turning from the consideration of the animals which we have found in this cold upland region in winter, to those which, though their presence in such a locality might have been expected, are absent, we find the principal absentees to be:—

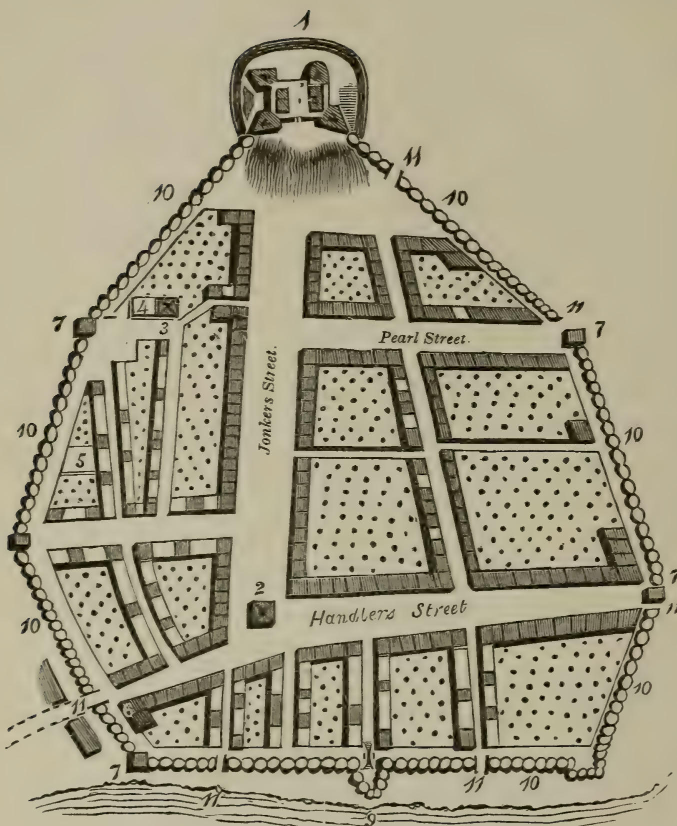
First. The moose, caraboo, deer, and the small or common gray rabbit. The marmot and the chipmunk or ground-squirrel are not to be expected, being winter sleepers, and seldom appearing during severe winters.

Second. The bear, porcupine, raccoon, wild cat or bay-lynx, wolf, fox, and the skunk — and, among birds the ptarmigan, blue-jay and cedar-bird.

Early hunters and explorers assert that about half a century ago the moose was abundant and the caraboo or reindeer sometimes found on the upland barrens. They are not now found anywhere in this vicinity either in summer or winter. The absence of the deer is more remarkable, but this may be readily accounted for by the cold, barren and sterile character of the country, and attractions of the more inviting lowlands, abounding in rich, juicy browse. Early in the winter the bear might have been expected, but not a single trail was seen, though within half a dozen miles in the lowlands their paw-writings in the snow were exceedingly abundant, and indeed hardly a week passed without the trapping and killing of one or more by guides, so that bear's meat, boiled, fried or roast — in default of anything better — became in our camp a constant dish. To the skull of one of these bears, shot by a guide in the Round mountain notch, I would call your attention, for a peculiarity in its dentition, as it lacks the exact number of teeth to which, according to classification it is properly entitled. This bear was killed at a spot elevated about 2,000 feet above tide. The porcupine (*urson*) can have no other excuse for its absence than the over abundance of the black-cat — its mortal enemy — who may possibly have exterminated it in this section. The absence of the wolf may be accounted for by his general scarcity; that of the fox by his being far too cunning to be found in any such cold country, and the raccoon also as a lover of the warmer lowlands could hardly be expected. The absence of the small gray rabbit or hare is a little surprising; perhaps it may yet be met with. The ptarmigan or white partridge is sought for in vain, and probably does not exist within the State. It would, undoubtedly, if introduced, find a livelihood upon the open or barren portion of Mount Marcy in summer, and secure sufficient support among the small dwarf timber in winter.

The blue jay which I noticed frequently this season at altitudes of from 1,000 to 2,500 feet did not show itself upon Mount Marcy, nor was a specimen of cedar bird noticed anywhere, even in the valleys or lowlands.

But what a strange and wonderful winter habitation have these mountain dwellers. The peak's appearance at a distance is now that of a vast snow cone or dome uprearing itself against the dark blue vault of heaven. Black ledges here and there show themselves in deep, sharp contrast with the spotless mantling around, and dark evergreen forests slope upward from the gloomy depths of the gorges; breaking, as the ledges are reached, into long, upward trending curves or belts of timber that struggle up the cliffs, diminishing and dwarfing till the timber line is reached. From the icy summit we behold a very different view. We stand upon the highest land in New York, the centre of an icy citadel! Frozen clouds drift slowly and wearily below. Away to the south and west in billows and billows of dazzling silver, they extend to where the horizon joins with them in mingled brilliancy. The sun sinks slowly westward. Behind us on each mountain side the deepening shadows of other mountains climb. The gorges begin to fill with unutterable gloom; and now the sinking sun shakes from itself for one moment the haze and mist, and covers our mountain with a burst of glory that makes it seem transfigured. All the frost wreathed forest on the sun-side slopes, bursts into sparkling light, each tree a weird Christmas tree, adorned with wonderful and fantastic frost work as though the frozen clouds had midst their limbs become entangled and, settling, enwrapped them all in silver fleece. The sun descends amidst the clouds; each white mountain peak beams with faintest crimson — then all is gray and chill and night.



PLAN OF ALBANY, 1695.

1. The fort.
2. Dutch church.
3. Lutheran church.
4. Its burial place.
5. Dutch church do.
6. Stadhuis, or City Hall.
7. Blockhouses.
9. Great gun to clear a gulley.
10. Stockades.
11. City gates 6 in all.

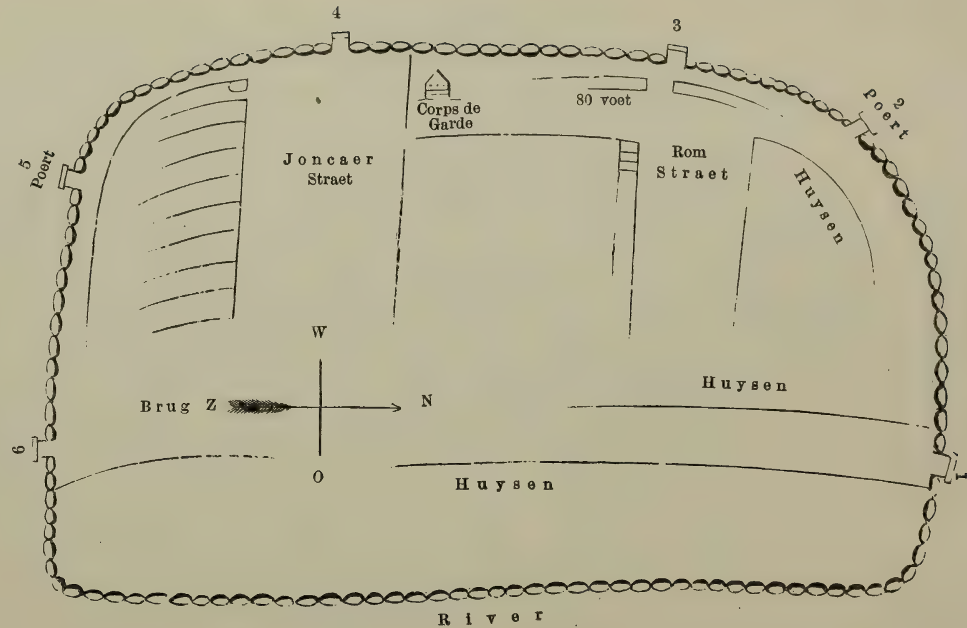
MEN AND THINGS IN ALBANY TWO CENTURIES AGO, AND THE ORIGIN OF THE DUTCH AND ENGLISH CHURCHES.

By Joel Munsell.

[Read before the Albany Institute, April 18, 1876.]

This diagram of the ancient city of Albany I used when speaking of the city a few weeks since, as it existed a hundred years ago; but the map belongs to a much earlier date. A hundred years ago, in the time of the revolution, the stockades had been extended to Hamilton street on the south, and the north gate stood a little above Orange street. I now propose to take you on a tour about the streets within the purlieus of these quaint old walls, for the purpose of pointing out, by the aid of the map, some interesting localities as they existed two hundred years ago, and to revive a memory of men and things long since departed, and whose places are now so differently occupied.

The original of this profile was made by the Rev. John Miller, chaplain of the English grenadiers in New York, who was the only Episcopal clergyman in the colony from 1693 to 1695, when he made drawings of the few military defenses then existing within the borders of this state. As we know from the present configuration of this portion of Albany, the map could not have differed much from the actual form of the city within its wooden walls. Pearl and Beaver streets are the only thoroughfares which the common council has left unchanged in name of all that this plan exhibits. It will be seen that the streets have now very nearly the same direction as then, and that the present curvatures were conformed to the courses which the stockades gave them.



PLAN OF ALBANY, 1670.

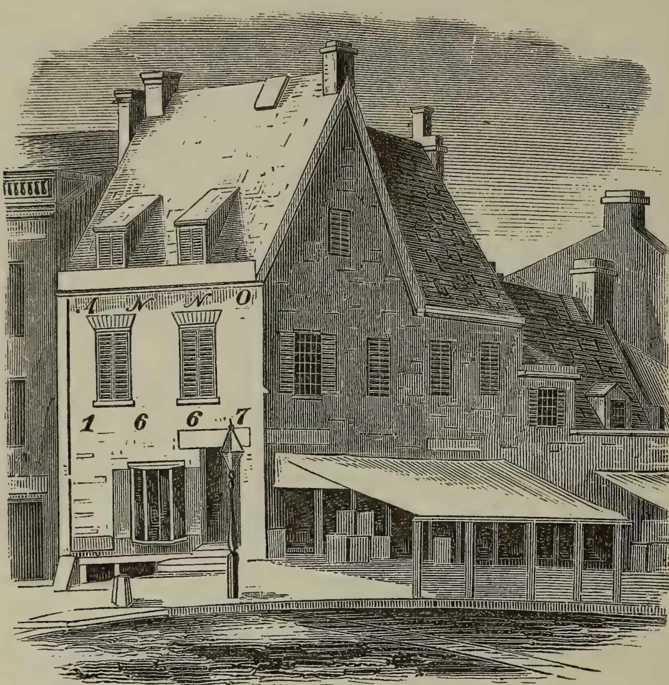
The oldest map of the city that has come down to us, which is supposed to be about thirty years older than this, extends its boundaries no farther west than the upper or west line of Pearl street, and extended north and south from Steuben to Hudson street. It exhibits these streets now known as Broadway, State, and Maiden Lane. The figures 1 – 6, refer to the gates. *Brug*, indicates where the Rutten kil was crossed by a bridge.

I hardly need to mention perhaps that those stockades were composed of pine logs thirteen feet in length, and about one foot in diameter, somewhat tapered at the end set in the ground, and were dowelled together near the top, leaving ten feet above the surface. The lines which they formed were changed from time to time, to afford more space for the increasing population, and undecayed portions of them are sometimes met with in digging for the foundations of new buildings.

When excavations were made a few years ago for the basement of the building on the south-west corner of North Pearl and Canal streets, the workmen uncovered a row of stumps of a stockade, which ran cornerwise across the lot, and a crowd of persons unacquainted with these ancient defenses was gathered there inquisitive regarding the origin of the phenomenon.

At the period represented by this diagram the north gate was at the upper end of Handlaer street, forming the barrier at the junction of what is now Broadway, and Steuben street, and the south gate was at Hudson street. There were no cross streets at these extremities, but what they termed the *rounds passage* was kept open for the patrol in times of threatened attack by the Indians or French.

What is now South Pearl street was only a narrow irregular lane leading to the Lutheran church and its burial ground adjoining on the south, bounded by the open Rutten kil, and all below, beyond the stockades, was called the plain. A gate swung across this lane at State street, and the house that stood on the lower corner is represented to have been elaborately finished compared with most of the houses of the time, being wainscotted and ornamented with tiles and carvings. It is found that this lot, nine rods on Jonker street, was patented in 1667 to Cornelis Steenwyck, and that Capt. John Schuyler occupied 55 feet of it in 1680. In that year what is now Norton street was laid out,



The Staats House, corner of State and South Pearl streets.

and was to have been continued to Broadway. The opening of this street extended the State street lots across the Rutten kil southward which before bounded on that stream.

Before Pearl street was opened to its present width, the corner house, removed for that purpose, was long known as Lewis's tavern. In one of these twin houses Madame Schuyler, the American Lady of Mrs. Grant, resided, during the time her house at the Flats was being rebuilt, and in one of them Gen. Philip Schuyler of the revolution is said to have been born. The committee of safety held its sessions here also. The street was for many years known as Washintgon street. The house now remaining on that corner is regarded as the oldest edifice in the city. There formerly ran across the front of these two houses, under the eaves, in iron letters, the words Anno Domini; and below, over the first story, the figures, also in iron, 1667. When the upper house was taken away, the word *ANNO* was left on the house still standing, and remains there now conspicuously; and I well remember when the figures were there also; but the owner, who was proud of them for a time, conceived the notion that the great age of his house tended to depreciate its value, and removed them.

As I am now speaking of matters pertaining to the present century, I may, with propriety, mention that Gov. John Tayler lived on the corner of Green street, and that after his death his house was removed and a portion of the lot taken to widen that street, about 1832. Gov. Tayler died in 1829, aged nearly 87. He had filled a large space in the political history of the state, and was the first president of the State Bank, where his portrait may now be seen.

Green street was early spoken of as the Vodden markt, that is, the Rag market, and later as Cheapside. It was finally named Greene street, in compliment to Gen. Greene of the revolution, and, raising a point in orthography it should on that account be written with a final *e*. Some of you will remember when it was a narrow street, merely wide enough to allow the passage of a single vehicle; and the city then being thronged with stage coaches — for at that period travelers were taken to every point of the compass by stage, and there being then three famous taverns, before they came to be called hotels, and Bement's recess there also — it was often so blocked that passage could be made but one way, and that was usually to the south.

There was the old Stone tavern, kept by James Colvin, and on the corner of Beaver was Dunn's coffee house, while on the upper corner of Green and Beaver was the City tavern, kept by Peter Germond, and previously by Hugh Denniston, known in colonial times as the King's Arms. The ancient sign of this house bore the effigy of King George, and one of the early outbursts of patriotism in the revolution spent its fury in wresting that obnoxious emblem of royalty from its hangings, and it was burnt in State street.

The mansion of Gov. Tayler, on the lower corner of State and Greene streets, is still dimly remembered, a broad two story house with a hipped roof, the front door divided in the centre into an upper and a lower door, like most of the old doors, the stoop provided with a bench on each side of the door, where he often sat in pensive contemplation after the manner of early times.

On the opposite corner of Green street, is still standing the store of the renowned William James, the merchant prince of the time, but less imposing in appearance now than when surrounded by one and a half story gable enders, and when five-story edifices were unknown. Mr. James died in 1832. His conspicuous position among the merchants of Albany, and his almost unparalleled prosperity in those days of lesser things, can hardly be appreciated by the younger portion of merchants. Another magnate was James Caldwell, whose residence was the present store of Smith & Covert, and his place of business was the Gable hall adjoining it. In my recollection portions of nearly all the houses from Pearl street to Broadway on the south side of State street, were occupied by families, and not a few gable enders were among them. Mr. John Van Zandt, the ancient cashier of the Bank of Albany, who was then nearly ninety years old, told me it was traditional that in those days of primitive simplicity and honesty, the houses on that side had an area or grass plat in front, upon which it was no unusual practice to leave clothes out all night to bleach.

Going back again a hundred years before the times mentioned as having tried men's souls, we find ourselves in the neighborhood of the Dutch church. The portion of Handelaer street below State was not yet known as Court street, nor the upper portion as Market street. Between State and Beaver was what was called the Great bridge, over the Rutten kil. The Rutten kil had its origin in copious springs on the upper side of Lark street, and as if out of the pond that once stood there, I perceive has arisen the spire of an imposing church edifice. Timbers of great length were sometimes ordered by the common council to span this creek in making repairs to the bridge. It was undoubtedly then a formidable stream, which had been populous with beaver and stocked with fish; now merely a sewer, with an exuberance of rodents!


Portrait of Pieter Schuyler.

Adjoining the creek on the south side was the residence of Pieter Schuyler, the first mayor of Albany, son of Philip Pietersen Van Schuyler (1650), who often wrote his name simply Philip Pietersen, that is, Philip the son of Pieter, to distinguish himself from some other Philip, perhaps, such being one of the mysteries of the ancient Dutch nomenclature, chiefly useful in our time to puzzle the student in antiquarian lore. If one has the perseverance to overcome the difficulties thus thrown in his way, it is suggested whether he might not be regarded as entitled to the degree of

LL.D.—*Learned in Low Dutch!* This Pieter Schuyler, the mayor of 1686, is memorable for having accompanied the Mohawks to England, in the time of Queen Anne and the Spectator, on which occasion his portrait was painted, as is supposed by Sir Godfrey Kneller, and is still preserved at the Flats among the family relics, by Mr. John Schuyler. The accompanying engraving is copied from it.

State street below Broadway was called Abram Staats's alley, because the doctor, the progenitor of the Staatses of Beverwyck (1642), occupied the front of the Exchange lot, and behind him on the east was the brewery of Volkert Janse Douw, the first of that name here also (1638). The residence of Volkert Janse was on the upper corner of State street opposite, which lot has belonged to the family nearly 250 years. Probably there is not another instance like it in the city, if we except that of Van Rensselaer. This alley was afterwards extended in width, and called Little State street, and finally widened to its present extent, and the term Little dropped. When I see the lower part of the street several feet under water, and the owners of stores wading about in rubber boots prodigiously elongated upwards, or paddling about in boats to learn if their goods have been lifted above high water mark, I am reminded of the tradition told me by Cornelius Truax, half a century ago, that when the Yankees came over and began to build below Dean street, the Dutchmen told them that if they had seen the river break up they would not build there.

Here we recognize on the map the late Exchange street, formerly known as Mark lane, now obliterated to give verge and scope to the ambitious designs of the government architect of the new custom house. A street or alley ran down between this street and Maiden lane, which was long since closed up; and next comes Maiden lane itself, spoken of in the records as Rom street — the origin of the name can only be conjectured.

On the lower corner of Maiden lane and Broadway, Harmen Harmense Van Gansevoort, so he wrote his name (1660), the progenitor of that name here, purchased the lot in 1667 of Paulus Martense Van Benthuysen, the first of the Van Benthuysens here, and located a brewery, which gave to the lower part of the street the name of *Brouwer's straat.* Here, in a house standing within the

NORTH MARKET STREET, 1805.

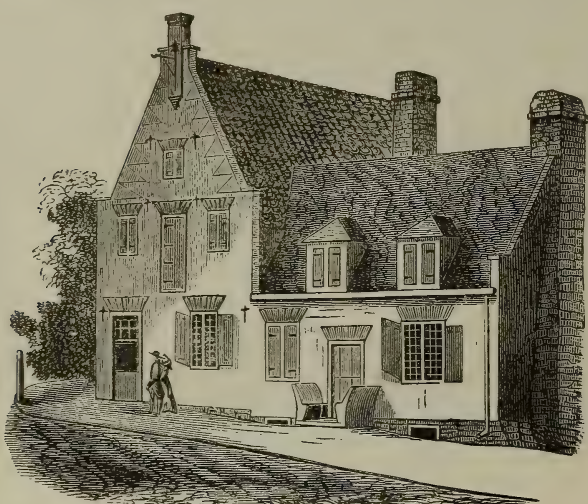
2 Gansevoort. 4 Hun. 8 Market. 10 James Kane. 11 Church.

memory of the sexagenarian, was born the famous Gen. Gansevoort, of the revolution, whose son, just passed away, erected a noble edifice to mark the habitation of his ancestor, the hero of Fort Stanwix, the present Stanwix Hall hotel.

Other notable citizens of the olden time might be mentioned here, if time and your patience would permit.

The space between the city wall at Steuben street was also called the rounds passage, twenty feet wide. In time of peace the common council had much difficulty to keep the owners of adjoining lots from infringing upon it. These defenses were a great tax upon the people, and severe orders in council were often issued compelling persons to haul their quota of logs to repair the stockades opposite their premises, and occasionally it is found that a woman, somewhat tardy in performing the same service, is sternly commanded to "ride" her stockades.

Outside of the stockades north on the line with Pearl street, was erected in 1710, by the father of Col. Jacob Lansing of the revolution, the house still standing there,



Pemberton House, 1710.

and known as the Pemberton house, on the corner of Columbia street. This house was so constructed that no two adjoining rooms were on the same level, but on stepping out of one room into another it was necessary to ascend or descend two or three steps to the next. The ceilings were not lath-and-plastered, but the beams and sleepers were polished and waxed, and the jambs of the fire places were faced with porcelain, ornamented with scripture scenes. The same peculiarity may be seen in the construction of the floors of the Staats house, now the corner of State and South Pearl streets.

For a long time the north gate was at Steuben street, defended by a block-house, on which cannon were mounted. There were matters of some interest beyond it, but we can merely stop to mention the great fire of 1797, which rendered one hundred and fifty families houseless, from Steuben street northward — the second great fire of the city.

In returning to State street, we pass the residence of Dr. Samuel Stringer, of the revolution, still remaining in

NORTH MARKET STREET, WEST SIDE, 1825.
17 Barent Bleeker. 18 John H. Wendell. 19 Dr. Stringer. 22 Sanders Lansing. 23 Chancellor Lansing.

the block on the west side of Broadway below Steuben, but somewhat disguised by modern changes. This was the first house in which white marble was used for sills and caps for windows. Adjoining his office on the south, dwelt Gen. John H. Wendell, of the revolution. These two veterans adhered to the costume of the olden time till their decease, the latter being the last of the cocked hats, in 1832. This part of Handelaer street, that is, Merchant's or Trader's street, came to be called Market street about

1790, when a market-house was built in the centre of it below Maiden lane. Noticing trifles as we proceed, I will mention that this market was removed to a vacant lot behind the old Lutheran church, now forming the corner of Howard and William streets, where it was long famous as Cassidy's and Friedenreich's market, but more significantly termed the Fly market, and still stands there, in the guise of an oyster shop and a *sample room* — an institution unknown to the *ouders* under that name.

We have now returned to one of the most notable localities of this notable city — the Dutch church. But before entering its venerable porch, allow me to speak of its predecessor, the first church of the colonists, built, we are told, in the pine grove, somewhere in the neighborhood of the present steam boat landing, in 1644. Being the first church edifice erected in this region, it serves to mark the progress of church architecture to mention that it was provided with pews for the magistrates and deacons, and nine benches for the congregation, at an expense of about $38. Here Megapolensis was engaged in his ministrations when, in 1648, the grim Peter Stuyvesant came up from Manhattan, and took possession of Fort Orange and all that eligible ground, and four years later forced the inhabitants that had settled around it to remove, and give scope to the guns placed there to defend it. He also seized a strip of the patroon's manor, one mile wide and fourteen miles long, in the name of their high mightinesses, the states general of Holland. This gives Albany its singular appearance on the map, which so many have remarked without being able to account for. It gave the government a military road through the patroon's manor into the vast country beyond.

The people being forced away from Fort Orange, began more actively to build on the higher ground at the corners of State street and Broadway, and the new cluster of habitations was called Beverwyck. The patroon had already planted his colony farther north, and his tenants stretched along the territory extending from Stuyvesant's city line northward, known as the Colonie, the nucleus of Rensselaerswyck. Speaking of the city line gives occasion to mention that when Gov. Stuyvesant took possession of the territory which afterwards comprised the city of Albany, he planted a cannon at Fort Orange and firing a ball north it struck the ground at Quackenbush street, and the ball sent south spent its force at Gansevoort street; and the territory within that space, about one mile in distance, was made the bounds of the future city, and the lines run at right angles with the shore of the river at this point, gave a northwesterly direction to the tract so taken for public use; and the English governor, Dongan, in 1685, exacted this concession from the patroon before granting him a patent for the manor.

These different villages or settlements led to misunder standing, the whole region being often designated as Fort Orange, whereas the fort was the government seat, located on the exact ground now occupied by the Susquehanna rail road office. Beverwyck was a distinct hamlet or village, and so called until the English took possession of the country in 1664, when its name was changed to Albany. But the Dutch recovered their territory in 1673, when for about a year it was known as Willemstadt.

After the church was removed from Fort Orange, the foot of State street was chosen for its location, where it was built and occupied in 1656. It was a small wooden structure, which remained in use about sixty years. The circumstances leading to its successor in 1715 are somewhat curious and interesting. The occupancy of the country by the English, according to the usual course of things, attracted the immigration of another nationality, officers of the government and adventurers of all pursuits, who in course of time proceeded to organize a church different from the established one of the Dutch Reformed, whose services were conducted in a language unintelligible to the new comers, and they determined to build a house of worship. Taking no counsel of the Dutch, they fixed upon a site at the head of State street, under the guns of the fort, opposite Chapel street, and applied to Gov. Hunter for the ground. He gave permission to take sixty by ninety feet, and supplied all the stone and lime for the building. The common council regarded this proceeding as an unwarrantable infringement of their rights, claiming that the charter conferred the title to the ground upon them, and offering the English an eligible site for their church elsewhere, forbade its location in the street. The governor and rector being inexorable to all remonstrances, and the crisis being imminent, they sent an express to New York in a canoe for the advice of two eminent counsel. Meanwhile the workmen disregarding the injunction of the council, two masons were imprisoned for contempt; but they were admitted to bail or liberated by the governor and the work went on to completion. It was a stone edifice forty-two by fifty-eight feet, without a tower, and was opened for service in 1716.

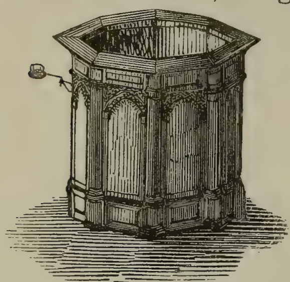
The Dutch Reformed, finding themselves unable to shape the business to their liking, set about a much wiser enterprise. They began the erection of a new church of stone, on an enlarged scale, and pursued the work with a zeal and alacrity which has ever since been a subject of admiration to their posterity. The foundations were laid around the old church, and the walls carried up and enclosed before the old one was taken down, and carried out through the doors and windows, so that the customary services were interrupted only three Sundays, and they occupied it before the English had completed theirs. It stood in use until 1805, a period of 90 years, and it is recorded in a Dutch Bible now in the possession of Dr. Thomas Hun, that a child baptized in the church on the first Sunday it was so used, was Elizabeth Vinhagen, and that the church bell was tolled for the last time at her burial, she having died in her 92d year.

The Dutch Church of 1715–1806.

The street was now occupied by this church at its foot, by a market house below Pearl street, and by the Episcopal church at its upper extremity; while the battlements of the fort stood upon a lofty eminence overlooking the city, and stretching nearly across the entire width of the present street on the west line of Lodge street, the road to Schenectady winding around its angles.

We are now prepared to enter the church and inspect its interior. The porch was on the south side, and the ancient stepping stone was retained in its original position half a century after the church was removed, serving to point out the precise spot of the entrance to the vestibule, the wear of the footsteps of several generations in passing to their devotions having given it a peculiar conformation. Tenants of the opposite buildings watched it for many years with pious care when the pavement was being repaired; but when they had passed away, some one lacking knowledge insisted that it was wrongly placed and induced the paver to remove it to the centre of the street, after which it was thrown out altogether and lost to the antiquary. The church stood so nearly across the street, that only a cart-way remained on either side. In length it extended east and west.

On entering the audience room, the pulpit was observed on the north side, octagonal in form, barely large enough



for one to speak in, having a bracket in front on which was placed an hour-glass to measure the length of the pastor's discourse. It served the two edifices a hundred and fifty years, and is still preserved. The seats were slips after the manner of modern churches, but instead of sitting in families, each sitter had an appropriate seat and cushion, which seat was occupied during life, and afterward transferred to the nearest of kin, on payment by the latter of a fee for the transfer. The seats accommodated 611 women, who occupied the entire body pews of the church, and there was an elevated bench extending around the wall, which afforded seats for seventy-nine men. This was the entire capacity of the church until galleries were added at a later day.

It is traditional that when there was danger of invasion, the men sat with their guns by their sides, wearing their hats and muffs, and smoking their pipes during the sermon. The walls were perforated near the top, with loop holes for the use of musketry. To this vigilance the inhabitants owed their immunity from invasion, for the city was never beleaguered by any foe.

I have a plan of the interior of the church, the ground floor taken from a pen drawing of the slips, which had been promised to me for several years by Mr. Samuel Pruyn, and which he left with me, providentially, as we are accustomed to say of the smallest events, only two days before he died, or we would now have no clue to the form of the interior. It is seen from this that the bell was rung in the middle aisle, and that the stoves were placed on a level with the galleries, supported on posts, and that the smoke pipes went out through the wall. The last of the sextons in this church was Cornelis Van Schaick. Having finished ringing the bell he tied the bell rope around the post, placed in the aisle for the purpose, and went up into the galleries to inspect his fires. He clambered over the front of the galleries, and, having filled the stove with wood, closed the door with such unconscious force as to produce a tremendous bang.

The fronts of the galleries were studded with nails, upon which the occupants of the seats hung their hats, as is seen in one of Hogarth's pictures, so that the manner and custom was not peculiar to this locality; but it presented a novelty to the stranger which was rendered the more picturesque and attractive by the variety of their style, color and condition. The roof was ceiled upon the rafters with boards, from the walls to the cupola, and a chandelier supplied with candles was suspended in the centre. The windows were in the style of what is now termed French, that is in two frames opening laterally on hinges; and were composed of smaller compartments or sashes, containing twelve panes each, representing the name and family arms of the person at whose expense it was placed there — the glass stained by a process said to be lost. The panes were about five inches square, and so little care was taken of these family escutcheons when the church was removed in 1806, that but four of them are known to have come down to our time entire. I have a portion of one of these sashes bearing the name Herbertsen, 1657, the pane showing the crest having been given away before it came into my hands.

Church Window, 1656.

The accompanying engraving of the window of Philip Schuyler, shows the style of all of them, except that it omits the division marks into 12 panes.

Of the very few relics of the old church that were preserved, was a pole with the bag attached to it, that had been used for many years in taking the collections. Those collections were gathered ostensibly for the poor, for the only poor house was owned and maintained by the church.

I can't refrain from giving an instance of the expense of burying a church pauper. On the 15th of February, 1700, Ryseck, widow of Gerrit Swart, the last survivor of the church poor at that date, died and was buried on the 17th, the expenses of which are copied from the deacon's book. It is entered in Dutch, but I think you will be content with English: Three dry boards for the coffin, 7 guilders 10 stuivers; ¾ lb. nails, 1*g.* 10*s.*; making the coffin, 24*g.*; cartage, 10*s.*; a half vat and an anker of good beer[1] 27*g.*; one gallon of rum, 21*g.*; 6 gall. Madeira for women and men, 84*g.*; sugar and spices, 5*g.*; 150 sugar cakes, 15*g.*; tobacco and pipes, 4*g.* 10*s.*; digging the grave, 30*g.*; use of the pall, 12*g.*; inviting to the funeral, 12*g.*; Mary Lookermans was paid 6*g.* for assistance at the burial, and Marritje Lieverse for nursing 39*g.* Total 289*g.*, or $115.60. The expenses of maintaining this person four years had been 2,229 guilders 10 stuyvers.

It was an important duty of the deacons to collect and disburse this poor fund, the accumulations of which at one time amounted to nearly fifteen thousand guilders. As early as 1647, three years after it was organized, the church was rich enough to loan money to the patroon, and the earliest record that remains in its archives is an item of a loan to a woman upon a pawn of silver ware. It was the province of the young deacons, as they were called, that is, of the two last elected to the office, to take up the collections. The custom was for the domine to halt in the midst of his sermon, when the deacons presented themselves before the pulpit, facing the audience, with each his staff having the bag and bell attached, which they brought to a perpendicular position against their shoulders

[1] An anker was 10 gallons, and a half vat about 11 gallons. Good beer was strong beer, ale. A guilder was nearly 40cts. and a stuyver was nearly 2cts.

in military style, whereupon the pastor pronounced a blessing upon the collection about to be taken. These poles enabled them to pass the bag attached to it before every person in the slip, and if from any cause one was drowsy or otherwise inattentive, the tinkle of the bell gave notice of the required duty; then the bag was passed expertly over the heads in that slip and drawn leisurely back before the eyes of the occupants of the next one. The audience being thus thoroughly gleaned, and the domine having recovered his breath, he resumed the broken thread of his discourse. The practice of taking collections during the sermon was discontinued in 1795, in the time of Domine Bassett. In those days of staid devotion, the capacity of church goers for theology must have been much greater than at present, for it is matter of record that discourses were sometimes dispensed in an almost uninterrupted current for the space of two hours. Now some of us tire after forty minutes discourse; as if corroborating the theory of Buffon promulgated in the last century, that men and animals would deteriorate in this country!

In the first century of the colony, and some time later even, the currency of the country was principally wampum or sewan, the manufacture of the Indians from shells in the form of beads. The form of the receptacle of these collections concealed the amount of the gift, so that the munificent were not incited by ostentation, nor the needy to deposit their scanty pittance with diffidence. The collection so taken, however, was not unfrequently plentifully mixed with a variety of coin unrecognized by the statute, consisting of any substance that fell into the bag with a chinking sound. The deacons, to rid themselves of this class of contributors, procured open plates; and although some of the sturdy mynheers resented the innovation by turning their backs and refusing their contributions, the open plates finally carried the day, and the gleanings eleemosynary ceased to be mingled with base coin. A sad fatality awaited the last relic of the old collection implements. An officer of the church, having only a practical appreciation for relics, cut the rod in two, and acquired a portion of it for a walking stick!

Bodies were allowed to be buried under the church in consideration of the payment of a sum for the privilege. There was at first a grave-yard in the street, adjoining the church on the west, and when the lot on which the Middle Dutch church now stands was appropriated for a cemetery, the bodies under the church were not all removed, it may be inferred, for in digging a trench on the north side of State street last year, it perforated the old foundation still remaining there, and human bones were thrown out. The dead were borne on the shoulders of men from the church to the cemetery on Beaver street. Although a trite subject to many of you, I will venture to mention that in process of time this ground on Beaver street was completely buried over, when a foot of sand was added to the surface, and a new tier of coffins placed upon the first, each coffin required to be square, and to be placed against the previous one. The ancient denizens of the city still repose there in three layers, and I wish every one of their descendants could be thoroughly imbued with a filial sentiment of the impropriety, to say the least, of ever parting with that ground; but that the church edifice now standing upon it might be preserved as a monument to the venerated dead beneath. The bones of Anneke Janse being supposed to rest there, and so great a multitude claiming descent from her, and large expectations from her estate being so general, what adverse influence might arise from a mercenary alienation of those bones, should give us pause!

Leaving this theme, we pass on to the place of the residence of the famous Anneke Jans or in the pronunciation of the vernacular, *Onneke Yonse*, which was the corner of State and James streets, the present site of the Mechanics and Farmers' Bank. As is now well known, through the industry of Dr. O'Callaghan, she came to Albany in 1630, with her husband Roeloff Jansen van Maesterlandt — that is, Ralph the son of John from Maesterland — for many of these settlers had no surnames, but were known as being the sons of their fathers, or took the name of the trade they followed, or the place of their nativity in Holland. Roeloff Jansen died in New York in 1637, and his widow married Dom. Bogardus. He was lost at sea in 1647, and she returned to Albany, where she died in 1663. The New York bouwery, owned by her first husband, was on the west side of Broadway, extending along the river from Chambers to Canal street, with a strip running up to give an entrance from Broadway. Although this farm was sold to the government by her heirs, and payment made to them therefor, and afterwards formed a portion of what was known as the King's farm, and subsequently donated by the government to Trinity church, a large number of persons are still entertaining a hope of deriving an inheritance from a partition of the premises.

In the last century, when the Indian tribes came to the city to receive presents or pensions from the government, they were gathered in front of the block on the north side of State street, between James and Broadway, and seated along the curbstone, where a division was made among them per capita, men, women and children receiving alike.

That square was entirely burnt over in 1793 — the largest conflagration known to have occurred down to that time — after which, about 1801, the Tontine, a grand hotel for the time, was built near the centre of the block, fronting on State street, a part of which remains in the stores of the late Abram Koonz and Durkee & Jenkins, topped out with two additional stories. There were no five story houses in the beginning of this century, perhaps none of four stories, unless we count some elevated gables.

The narrow space known as Middle alley was opened to its present width by curtailing the lots on the west side, and it was called James street. Frans Janse Pruyn, the first of the name here, is supposed to have located on the corner of Maiden lane as early as 1665, and his descendants occupied the premises until 1865, two hundred years, when it passed to other hands, the last occupants of the premises of that name having deceased without posterity.

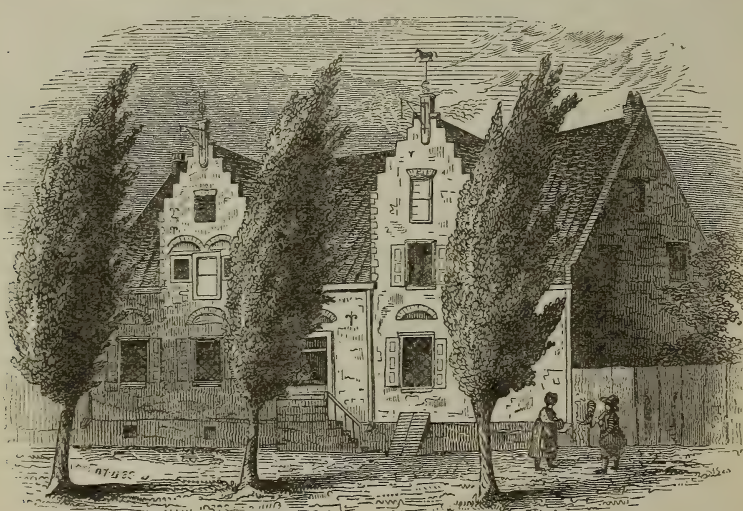
The first occupant of the Hope Bank corner was Evert Janse Wendell (1663–1704) the ancestor of a numerous posterity; and on the corner above, Gerrit Wynantse located, the progenitor of the Vanderpoels. The old Lydius house,

North Pearl from State Street.

Elm Tree Corner. 3 Vanderheyden House. 6 Lydius House.

which stood here till 1833, was taken down by Mr. George Dexter, who now owns the premises, and who thinks it was built by Dom. Schaets, and that all the material, bricks and timber, were brought from Holland. But as Dom.

Schaets was here from 1652 to 1683 as a preacher, when he was succeeded by Dom. Dellius, and died in 1694; and that in 1664 the lot was patented to Jan Thomasse, after which it was transferred successively to Cornelius Steenwyck, and Jochim Staats and Jacob Tysse Vanderheyden, all in the time of Domine Schaets, it is inferred that it must have been Domine Dellius or his successor, Domine Lydius (1700–1709), instead of Schaets, who had the house that stood there; which latter is the more plausible from the fact that his grandson, Balthasar Lydius, occupied the house and died there in 1815. The records are often quite fatal to the most fondly cherished traditions. Yet this was one of those quaint Dutch edifices so common half a century ago, when Pearl street, as well as the other streets of Albany, abounded in gable enders, surmounted by iron horses in the attitude of doing a mile in 2:40, and also by other devices, mindful in all seasons of the true course of the wind; and by various other ornamental conceits in



Vanderheyden House.

iron, designed to strike the beholder with awe and admiration. The Vanderheyden house especially, which occupied the site of the Perry block, had a weird fame, and its fantastic iron finicals were so attractive to Washington Irving that he procured them when it was demolished to decorate Sunny-side.

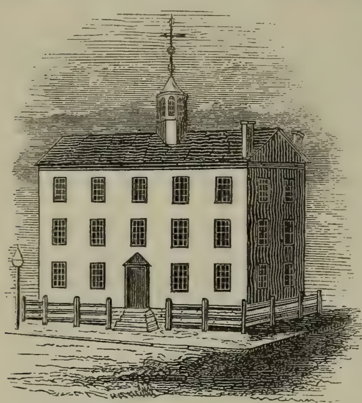
Passing to the elm tree corner, we have the site of the residence in the middle of the last century of Philip Livingston, one of the signers (with whom the elm tree is supposed to be coeval); afterwards of the famous publishing house of Websters & Skinners, and now of Tweddle Hall. Adjoining it on the west is the mansion still standing erected by the younger brother of the Patroon, Philip S. Van Rensselaer, seventeen years mayor of the city — now occupied by Erastus Corning. On the opposite side of State street, adjoining the property of the late Erastus Corning on the west, was the residence of Robert Yates, one of the first justices of the Supreme Court of the state, and in 1790 chief justice. He was one of the members of the convention that framed the constitution of the state, and also of the United States, and is characterized as a man of great intellectual powers. The site of this house is now occupied by the residence of Philip Wendell.

Yates House.

This serves very nearly to complete the circuit of the city, as far as we have time to observe and comment upon it, seldom containing within its wooden walls 3,000 inhabitants, nearly a third of whom were soldiers and blacks. It is found that the population in 1689 was 2,016. In 1697 the census ordered by Gov. Fletcher enumerated but 1449, showing a diminution of 567, of which 16 had been taken prisoners, 84 killed by the enemy, 39 deceased, and 419 had removed to places of greater safety. On the conclusion of the war between England and France the population rapidly increased for nearly half a century.

The Indians who came to dispose of their furs were lodged in Indian houses outside of the stockades, not being allowed to remain over night within the gates, so watchful were the authorities against surprise at all times.

The Stadhuis, or City Hall, on the corner of Broadway and Hudson streets, served for the courts, the meetings of the common council, and for the confinement of criminals. In the time of the revolution disaffected persons and all sorts of desperate characters were confined here in unusual numbers. At one time several who had been condemned to execution were incarcerated in a lower room, where the door of the apartment swung in a place cut out lower than the level of the floor. When the sheriff came to take them out he found the door barricaded. He procured a heavy piece of timber and endeavored to batter down the door. During the attempt the voices of the prisoners were heard threatening death to those who should persevere in the effort to molest them, stating that they had laid a train of powder to blow up themselves and their assailants. While a crowd gathered and were looking on to see the end of this singular affair, some one suggested the idea of getting at them through the ceiling. The prisoners renewed their threats of vengeance, certain, speedy and awful while this was being effected. The assailants persevered, nevertheless, and having brought the fire engine, the room was suddenly inundated and the train rendered harmless. How to descend was still a difficulty, as but one could do so at a time, and the disproportion of physical strength that apparently awaited the first intruder, for some time prevented the



The City Hall, 1806.

attempt. At last a merchant, by the name of McDole, exclaimed, "give me an Irishman's gun, and I will go first." He was provided with a formidable cudgel, and with this he descended, and the moment he struck the floor he leveled the prisoner near him, and continued to lay about him valiantly until the room was filled with a strong party, who came to his assistance. After a hard struggle the culprits were secured, and the door, which had been barricaded by brick taken from the fire-place, was opened. They were taken, seven in number, and marched up State street, dressed in white, and executed near Elk street upon the gallows.

The last person who was marched through the streets in this way, clothed in white, preceded by a cart bearing his coffin, was Hamilton, who shot Maj. Birdsall, in 1818. Strang who shot Whipple in 1827, and was the last murderer executed in public, was taken from the jail, corner of Eagle and Howard streets, a short distance to the gallows erected in the ravine, where High street now crosses Hudson street, and there executed in the presence of 30,000 spectators, who filled that natural amphitheatre in which no house then existed.

It was this ancient Stadhuis that the first convention of the provinces was held in 1764. The legislature held its sessions in it at a later day, until 1806, after which it was converted into a museum, where a few will remember the marvels of the phantasmagoria, the array of wax figures, the Witch of Endor, and other attractions that for so many years excited the wonder and admiration of the juvenile citizen and the unsophisticated rustic, under the management of Harry Meech. When removed from this place, that depot of relics, natural and artificial, had a long sojourn on the ancient Johnny Robison corner (from 1830 to 1855), in what is still known as the Museum building; and it may be interesting to know that when the institution was broken up, its celebrities were carted away, and Sir William Wallace, Charlotte Temple, Gen. Jackson, the Goddess of Liberty, the Witch of Endor, the Sleeping Beauty, the big turtle and the organ, were dumped promiscuously into a canal boat, whence they found their way to the Mississippi, and were set up anew in a floating museum, and for aught that is known to the contrary, are still voyaging up and down the father of waters, and thrilling thousands of admiring people with a pang of sweet emotion, as of old in Albany.

[For a more particular and more extended account of some of the localities and ancient streets, the reader is referred to the *Collections on the History of Albany*, vol. II, pp. 9–31; and to the *Annals of Albany*, passim; also to Prof. Pearson's *First Settlers of Albany*.]

THE SOLAR THEORY OF MYTHS.[1]

By Prof. John DeWitt Warner.

[Read before the Institute, Dec. 7, 1875.]

In the old Roman capital were guarded the rolls which Tarquin the proud, awe-struck at least once in his life, had bought from the sibyl. The most venerable council in the state was the conclave of augurs that pored over the weird symbols, and from their confusion tortured dubious prophecy. At Delphi, the Hellenic soothsayers caught from the frenzied Pythia the words which decided the fate of empires, while in the midst of the Lybian desert the Egyptian priests gave to inquirers the portentous utterances of their ram-headed divinity. To learn of the future from the divine powers was the most serious business of the old world.

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[1] The following volumes are mentioned as being among the most important as well as most accessible publications upon the theme treated in the present essay.

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Lange, J. P. — *Theological and Homiletical Commentary on the Old and New Testament.* New York, 1866–75, 17 vols., 8vo.

Tylor, Edward B. — *Primitive Culture.* London, 1874, 2 vols., 8vo.

Gladstone, Wm. E.— *Juventus Mundi, or Gods and Men of the Heroic Age.* London, 1870, 8vo.

But there slowly came a change. Though the Roman admiral, who cast the sacred fowls into the sea, lost the engagement from the horror and fear with which this proceeding filled his soldiers, his successor did not the more venerate the holy birds, but took good care that they should be hungry enough to eat with a truly inspired avidity. The Pythia, for the best of reasons, pronounced Philip of Macedon invincible, and Alexander gave Jupiter Ammon the choice of flattering his pretensions, or losing his own divinity. Men became more practical, and, ceasing in a degree the attempt to spy out the future, sought to control it. They neglected Apollô, and, making their own prophecies by reasoning from what had been done, fulfilled them by their own energy and skill. When Herodotus and Thucydides stated facts as their standard, and then tried to reconcile the supernatural with them; when Livy told the time honored traditions of regal Rome, with a critical "Nescio an" as a preface, Olympus was already doomed, and the gods of the bright æther already on their way to all-receiving Dis. Men still shouted "Great is Diana of Ephesus," but the silversmiths were the only ones who heartily sounded the cry. The responses of Delphi were still prized, but mainly on account of the prices paid for them. The Roman youths and maidens still sang the carmen to Apollô and Dian at the secular games, but their best known chant was written by the most brilliant of Rome's skeptics. For two thousand years did history steadily encroach upon mythology, till the gods and heroes of the old religions slept in oblivion, or still less fortunate, came down from their celestial thrones to fill the literary stage as the characters of the old-world pantomime. On the other hand, the records of what had been were sought for with an ever increasing avidity. As time unfolded a historic future, men unraveled a historic past; till, back through the labyrinth of the ages, they followed the slender thread of tradition and stood at the portals of the Mosaical paradise, awed by the flaming sword of the angel that guarded the gate.

Here, as they thought, was Ultima Thule, and retracing their steps, they filled the long way over which they had traveled with the monuments of the fancied mortals who had made the past illustrious, till the historic page was filled with the record of princes who had never lived, and the historic world crowded with the mausolea of heroes who had never died. But, though overshadowed by the new learning, and crowded out by the new religion, the deities of the old world had filled too great a place to be easily forgotten. The grandest conceptions of architecture were crystalized in the walls of their temples; the grace and majesty, which the modern world admires but cannot rival, were embodied in their marble forms; the noble simplicity of the epic, the terrible grandeur of tragedy and the light imagery of comedy were grouped about their divine proportions. They were still mighty, though fallen. The historian and the philosopher seized upon the ruins of the old-world pantheon, and each in his way used its materials for the building of his own edifice. And hence arose two methods in the interpretation of myths which we may term the allegorical and the historical. Of those who held to the former, or allegorical, Aristotle very naturally concluded that the strange creations were but the attempts of the world before him to express their philosophical speculations; Plutarch, that they were metaphysical statements in disguise; Thucydides inclined to the idea that they might be explanations of the course of nature; Cicero that a great part of them were but natural powers personified; Sallust that they were mysteries — in which opinion most people probably concurred; while Sir Francis Bacon had, of course, an original solution: proved, conclusively to himself at least, that they were moral maxims dressed up in allegory, and then showed what ingenuity could accomplish by finding the moral in some thirty of the most famous.[1] But by far their most remarkable treatment was made by Court de Gébelin, in the latter part of the last century. His scheme was no less than to bring together into one whole the languages, religions and philosophy of the world. Sanscrit was not yet known, yet this man already maintained theories, into which the discoveries of Sir William Jones led the later investigators; philology was scarcely in existence, yet we find in his pages the same principles applied, and, in many cases, the same results attained, that, when offered by Müller, are hailed as wonderful discoveries; and his writings read like a production of our centennial year, instead of what they really are, a work one hundred years old. He recognized a unity in systems apparently so diverse, and concluded that they were but figurative statements of the principles of agriculture, in which the central figures were the sun as he passed over the signs of the zodiac and the farmer, for whom he marked out the periods of seed time and harvest. So much for the allegorical treatment of myths.

The historical plan was first adopted by Euêmeros who lived more than three hundred years before the Christian era. By the Indian sea, in a country which he called Panchaia, he claimed to have seen a brazen column, which Zeus as an earthly monarch had set up as a memorial of his victorious march. He soon broached the theory, supported by facts manufactured at a wonderful rate, that mythology was but history; that the gods were but human conquerors, and the wonderful stories concerning them but exaggerated accounts of events which really occurred. He was rewarded for his pains by the universal detestation in which he was held by his countrymen and the epithet of atheist justly fastened upon him. More than a century later, Ennius translated his writings into Latin, Polybius adopted his views *in toto*, and in the early Christian centuries, the fathers, led by St. Augustine, lauded him to the

[1] Bacon — *Essays on the Wisdom of the Ancients.*

skies as the one clear-sighted man in a blind nation. From the ground which the church took, and also from the fact that the explanation had at least the merit of simplicity, this theory, though never adopted by the more advanced thinkers, has been the one generally held. But the Abbé Banier, who died in 1741, not only supported this view, but laboriously compiled all that could be found concerning the pagan gods and heroes, arranged his material so well and explained it so cleverly, that the reader can scarcely avoid hoping that it may all be true. He did the work too well to need successors, and from the translations of Banier has been derived the lore which cumbers the notes upon classic authors, and the pre-historic genealogies which torture the schoolboy. Even now, as an example of pure, parrot-like conservatism, we find the *Encyclopedia Britannica* repeating the time-worn stories for which Euêmeros was indebted to an unlimited imagination.

But meanwhile geology and astronomy, not imbued with respect for classical learning and awe for hoary tradition, passed unheeded the "procul, procul este profani," set up in their path, and, far beyond the old boundary, found the records of a measureless past, literally graven upon tablets of stone. As long as the veil had never been lifted it might seem plausible that nothing lay beyond; but when behind it the path was still discerned, obscure yet real, theory yielded to fact, and the chroniclers began to write the story of a past so long forgotten. A new ally was called in. Language, hitherto but the herald of sovereign man, was made to tell its own marvelous history; individuals no longer stood forth as the objects of speculation, but the story of races was written, and back of the so-called historical stretched a philological past. Individuals gave place to nations, nations gathered themselves into races, races were grouped into stocks, and it seemed that we must meet with humanity as one whole from which all races have diverged; when, just before the longed-for goal, the clue failed. Greek and Latin, Sanscrit and Gothic melted into Indo-European; an almost equally numerous family grouped themselves as Semitic; still others as Turanian or rival stocks, but that was all. They stood distinct, and if their paths did converge as they receded, they did this too slowly to seem aught but parallel. But for the new emergency are found new resources. From the records left him the historian had traced the course of individuals; by the language which he spoke, he had marked the path of nations, and now, back of the written language, behind the spoken, did he find as guide the thoughts of humanity, its childlike explanation of the course of nature, its crude conceptions of an all-ruling divinity. No longer were Bel and Osiris and Zeus, Isis, Ashtaroth and Hêrê the mere children of fable; Apollô no longer disclosed the future but unlocked the arcana of the past; the queen of the fairies left the children she had loved so long; and touched with her wand the scholar; Tom Thumb was found a true porphyrogenite, and Cinderella the princess of a royal line, whose chaste splendor made cheap the courts of Susa, and before whose antiquity the house of the Pharaohs was an infant.

For researches into the laws, philosophy, fable and religions of different peoples showed that there existed between them a marvelous accord. This was found most marked in such respects as later civilization had least affected them; there was noted a strange parallelism between the religions of different races, a peculiar accord in the plan of their epic poetry, a wonderful agreement in the adventures of the heroes of their nursery tales; their theology, literature and story were seen to be but different manifestations of the same universal type, and — precedent to law and philosophy — to be the crystalized speculations of a baby world.[1] Not merely are general features the same,

[1] Fiske — *Myths and Myth Makers,* chap. I: *Origin of Folk Lore.* Gladstone — *Juventus Mundi,* chap. VIII: *Athênê and Apollô.* Tylor — *Primitive Culture,* vol. I, chap. III: *Survival in Culture,* and chap. VIII: *Mythology.* De Gubernatis — *Mitologia Vedica,* pp. 197 and 234.

but the very words in which the wondrous old story is told, are frequently so nearly the same, that they seem translations of a common text. The Hindoo mother quiets her babe with the same fairy tale that stilled the Grecian infant, and with which the sisters of New York or Boston amuse their baby brothers. Achilles, Moses and Hector, Sigurd, Romulus and good King Arthur, are born with the same halo about their cradles; as the heads of their peoples, and heroes of the same series of adventures, live parallel lives: then, with a convoy of celestials or by the direct agency of deity, step at once from the groans of earth to the thrones of heaven. With their attributes repeated in sublimer proportions, the bright warrior god Indra, the silver-bowed Apollô and the Immanuel of Christendom are the same as to the series of events in their noble lives, and many of the peculiar features of their supernatural nature. The more striking analogies are too well known to need that I should point them out. The fourth eclogue of Virgil and the glorious vision of Isaiah, the story of Samson[1] and the legend of Hercules are alike in their most striking features;[2] that the Lêtô of Homer is of similar type as the virgin of the evangelists, was long since noted, and has been recently argued by the learned Gladstone, who has also shown that Zeus, Apollô and Athênê are respectively the Greek equivalents for the three persons of the Trinity.

But it may be well to introduce a few examples; and so, as a basis of comparison, the legend of King Arthur will be correlated with that of Thêseus, the Attic king. The mother of Arthur was Igraine, wife of the Duke of Cornwall. She had been put into the fortress of Tintagil to keep her from the British king. But her husband was slain; Pendragon gained admittance in disguise, and possessed the lady who became the mother of his heir. Aithra

[1] De Gubernatis — *Mitologia Vedica,* p. 81.

[2] Lange's *Commentary: Book of Judges.*

the mother of Thêseus, was the beloved of Bellerophon, who with her took refuge in the citadel of Corinth from the attacks of Aigeus, the Attic king. But Bellerophon was defeated, the fortress with its fair occupant fell into the hands of Aigeus and she became the mother of Thêseus. Arthur was not to be the acknowledged prince, and was given at the postern gate to a poor peasant. Thêseus passed his boyhood in obscurity in Argos. At the death of Pendragon, Britain was torn by rival princes, till, in the great assembly at London, Arthur drew from the stone the brand Excalibur. Thêseus remains in poverty till with years comes the strength which enables him to raise the great stone under which lay his father's sword. Arthur, precedent to his coronation, repeated the exploits that had proved him prince, and Thêseus, on his way to Athens, performed the works denominated his six labors. Arthur upon his coronation, Theseus upon his recognition, start out on like rounds of conquest.

As Arthur slew the revolting nobles, so Thêseus conquered the usurping sons of Pallas; as Arthur laid low the giant, so Thêseus slew the Minotaur; as for Arthur and his knights, the holy grail is the object for which pilgrimage is to be undergone, so must Thêseus join the Greeks as they leave their fatherland to search for the golden fleece. Mordred, the bastard son of Arthur, steals from him Guinever, his wedded wife, and Hippolytos, the illegitimate offspring of Thêseus, gains the affection of Phaidra, the Attic queen. As Arthur returned victorious from the continent to find his kingdom usurped and to die at the hands of the rebel, Thêseus, back in triumph from Colchis, finds his fair realm seized by his enemies. Arthur dying is committed to the mourning queens in the mystic barge; Thêseus, meeting a harsher fate, is cast into the sea from the Scyrian cliff.[1] As the

[1] This is the earliest extant form of the Thesean myth. The one made familiar to us by the "*Oidipous*" was a later and apparently arbitrary invention of the dramatist.

castle of Tintagil could not guard Igraine, as the citadel of Corinth was no shield for Aithra; so was the brazen tower of Acrisius poor protection for Danaê, and the temple of Vesta no guard for Rhea Silvia, and in Romulus and Perseus we see repeated Thêseus and Arthur. As Arthur was wrapped in cloth of gold, Apollô was swathed in golden bands, Perseus locked in the wonderful chest, Moses laid in the cunningly plaited ark, Romulus and his brother entrusted to the wooden trough, Adonis enclosed in the wonderful chest and Dionysius in like manner preserved. Not only Thêseus and Arthur, but Achilles, Moses, Romulus, Perseus, Hercules, Apollô Saul and David pass their youth in a manner strangely contrasting with their glorious future. Each has some all-potent weapon. Thêseus possesses the irresistible brand of his father; Sigurd and Achilles the lances that none but they can wield; Perseus the barbed weapon with which he slays the monster; Hercules the club deadly to the Nemean lion; Moses with his wand marshalled the plagues of Egypt and cleft the waters of the Red sea; Apollô's shafts brought pestilence to the Grecian hosts and laid the Python low, and with Excalibur, Arthur slew the giant. When Romulus has conquered the tribes about him and settled the Roman state he is slain by his own senators; Arthur, though conqueror in the final battle, dies by the hand of his son; Achilles, when by his valor Troy has been taken, is slain by a treacherous shaft at his wedding feast; Sigurd, the all-conqueror, is killed by the wound of the thorn; Thêseus returns from the successful search for the golden fleece to lose kingdom and life by the treachery of those whom he trusted; Hercules, always victor, dies by the arts of a jealous wife; Samson, the irresistible, meets his end by the falseness of the woman he loved. Each is never conquered but by treachery, each meets his end whence he had the least reason to expect it.

But to them death is not as to mere mortals. Arthur is not only "Rex quondam," but "Rexque futurus," king again to be: Moses sleeps at Nebo but appears in glory on Tabor; Elijah is to rise and lead the Arabs against Antichrist; Hercules is endowed with immortality; Romulus reappears and gives new vigor to the wavering legions; Boabdil sleeps in the mount by the Alhambra, and will one day lead the faithful to reconquer Spain; the Tells slumber at Rütli, to come forth whenever Switzerland shall be oppressed, and Barbarossa, in the heart of the Thuringian mount, waits till Germany needs a champion.

Each of these glorious personages is connected with an inferior, either as a brother, son or friend, bearing the same attributes in less marked form. Hêraclês the Hellenic Hercules, is accompanied by Iphiclês; Patroclos dimly reflects Achilles; Phæthôn is the son but not the equal of Phœbus; Thêseus is associated with the less famous Peirithoös; Castor is twin to his superor Pollux; Promêtheus blesses the world, only to be thwarted by the folly of Epimêtheus; Aaron is the brother, but not the peer of Moses; Remus is twin, but inferior to Romulus, and, preceding the divine child of Mary, came the inspired son of Elizabeth. It may here not be amiss in addition to these general comparisons, to follow out in detail, a parallel between two passages. In the second book of his Metamorphoses *Ovid* tells the story of Phaethôn;[1] in the fourth chapter of Revelations, *St. John* describes a vision of the throne of God in heaven. In the twenty-third line of Ovid's story, he describes Phœbus as "purpurea veste velatus," clad in purple robes. In describing the Lord of

[1] ——— "*Purpurea velatus veste sedebat*
In solio Phœbus, claris lucente smaragdis.
A dextra lævaque, Dies, et Mensis, et Annus,
Seculaque, et positæ spatiis æqualibus Horæ;
Verque novum stabat, cinctum florente corona;
Stabat nuda Aestas, et spicea serta gerebat;
Stabat et Autumnus, calcatis sordidus uvis;
Et glacialis Hiems, canos hirsuta capillos."

heaven St. John says, "he was to look upon like a jasper and a sardine stone," giving a general idea of glory but little differing from that of the Latin poet. Next comes the description of the throne, in Ovid. "In solio Phœbus claris lucente smaragdis." Phœbus on a throne glittering with bright emeralds. The evangelist says, "and a rainbow round about the throne like unto an emerald."[5] At the right and left of Phœbus stand the day, the month, the year and the centuries, none of which are mentioned in the Apocalypse, but, strange to say, the week, the only division of time omitted by the Roman, is supplied by St. John in the "seven lamps of fire which burn before the throne." We are told that about the throne of the sun-god are placed the hours at even distances, "positae spatiis aequalibus horae," while the sacred record reads: "Round about the throne were four and twenty seats, and upon the seats I saw four and twenty elders sitting."

But the chief figures in the description of Ovid are the four seasons, who were the principal personages of his court and, bearing each the emblems peculiar to himself, stood about the throne; enough, I think, to remind every one present of the four beasts whose strangely symbolical forms are so prominent in the vision of the inspired dreamer. Such coincidences are to be met with in every part of the sacred writings and epic poetry of all nations. They are too common not to be noted, too unmistakable not to be regarded, and, accepting the fact, recent investigators have sought to find the reason of these likenesses, and the common origin of the immense mass which they are compelled to class together. It was found that, by taking into consideration a great number of myths, gathered from nations most widely separated, minor differences being

[1] In the passage from the Bible above referred to, the only precious stones mentioned are the sardonyx, jasper and emerald. In Plato's description of the ideal world, to which he believed the virtuous passed at death, we find the same jewels mentioned as the common rocks in that glorious land. "— *σάρδια τε καὶ ἰάσπιδας καὶ σμαράγδους.*"— *Phædo,* 110, *E.*

eliminated, certain common characteristics remained. These became regarded as essentials, about which were clustered the minutiæ which caused the one to differ from the other. As might have been expected, it was also found that, the nearer we approached the infancy of races, the more these tales lost of their peculiar and non-essential characteristics; thus plainly hinting that their common origin would be discovered by examining their earliest forms, and also that, the more primitive the source from which they were taken, the more vivid and reliable would be the marks of their original. In India a sacred literature, dating back more than two thousand years before the Christian era, preserved in transparent form the myths so strangely and variously colored in later times, and in the earliest forms of Vedic allegory was the solution found.

In the Sanscrit tales, so fully explained by De Gubernatis, the hero is indifferently a personification of the sun in his celestial course, the bright god Indra, prototype of Phoibos Apollô, or the bull, the Indian emblem of divinity.[1] In short, the sun in his course through the heavens was the one object that, riveting the attention of the infant race, had ages before been personified as deity and transformed into the varied symbols under which he was worshiped. Appearing full orbed from the gloom of night, chasing away the darkness that flees before him, triumphing as conqueror in his noontide march, doomed to die in the Western ocean and fated to reappear with the morn, he is seen to combine the unvarying characteristics of the heroic forms we have just considered. Of hidden birth and unknown childhood, from the obscurity in which his youth is passed he appears as the full grown prince; benefactor of the world, he conquers the storm and dispels the clouds; then, by a mysterious fate, sinks into the waters of the West, ever to reappear and rescue the world from gloom. His anti-type and weaker self appears in the moon,

[1] De Gubernatis — *Zoölogical Mythology,* p. 12 et passim.

who, following with uneven pace, is now obscured by his glare at midday, as Remus yields to Romulus; now in his nightly absence is his vicegerent, as when pale Dian illy fills the place of her brother, the regal sun. It is now plain why in the West, where the sun sank, was placed the fabled wealth of the universe;[1] why Perseus should there find the golden apples of the Hesperides; why Arthur must die in the "great battle of the West;" why from the West of the Greek world should be lost the golden fleece which the solar heroes find again in the far Eastern realm of Colchis; why from Sparta in the West should be stolen the queen that another band of sun warriors should win in Eastern Troas; why in the paradise of the West, whose angel guarded the eastern gate, should be lost the purity, restored by the "Sun of righteousness," whose star was seen in the East. By the somewhat similar course of the sun in the zodiac are explained still other particulars. We can now see why Castor and Pollux are alternately in Hadês, in other words, the gloomy realm of winter; why Adonis remains six months in the underworld, and six in the bright æther the companion of Aphroditê; why Proserpine was one-half of the year the queen of Pluto, and one-half with her mother in the upper air, and why the Scandinavian Baldur is six months with Odin and the bright Æsir, and other six in the cold embrace of the blue lipped goddess of the dead.

The above stated theory is now generally accepted, and, although individual thinkers may except to certain conclusions, the foremost investigators agree that *the key to the strange parallels we have mentioned is found in their common derivation from the solar myth.* The point next in question is as to the extent of the conclusions, based upon it, that may be legitimately drawn. In this case the zeal of its friends has been far more harmful than the attacks of its enemies. Germany being foremost in historical and philological re-

[1] De Gubernatis — *Mitologia Vedica*, pp. 57, 58, 85.

search, it was there that the theory was first broached, and the general attention was first called to some of its conclusions by Strauss, the author of "*Das Leben Jesu.*" Taking the most ultra grounds, drawing the most extreme conclusions, he used the theory to overturn the authority of the Bible, and to destroy entirely, as he supposed, the foundation truths of Christianity. This naturally set the church in direct opposition to him, and, as so often happens in such cases, not merely doubtful conclusions, but well grounded principles, were attacked with equal vigor. It was soon seen that he had gone too far: and that, if his reasoning were allowed, not merely religion, but history, ancient and modern, would be annihilated. A learned prelate,[1] by a course of reasoning no more extreme than that of Strauss, proved that Napoleon was a solar hero and never had a real existence, while Washington was eliminated in the same way from the ranks of mortals. Thus came a division into two parties equally in error; the one believing that the solar theory completely overthrew Christianity; the other that the transformed story of Napoleon and the historical proof of a large portion of the scriptures as completely nullified the theory itself. But it was soon seen that, even though the theory was accepted, many of the conclusions of Strauss must be labelled "not proven;" and on the other hand that the clever travesties of well known historical characters, were but warnings against the misapplication of a principle, itself resting on too sound reasoning to be lightly disregarded. While the expression of a fact might be but the variation of a well known myth, it was seen that it might clothe the story of real events, in themselves important; that, among unlettered masses, nothing would be more natural, or in fact was more common, than to perpetuate the memory of men and events by attaching to them attributes and exploits which had long since lost connection with their source. But few

[1] Archbishop Whateley.

would question the existence of Charlemagne as a historical character, and it is no proof of his non-existence that we find him gifted with all the paraphernalia of the solar heroes, and in the barbarous Latin of many a bulky chronicle, the leader of crusades which set out centuries after his death. Barbarossa is a full fledged sun-warrior, but this is no proof against his real existence, and, on the other hand, such examples do not in the least exclude the belief that the various myths have plainly one common origin, which is the course of the sun. That the crop of heroes and demi-gods, which among barbarous peoples grows afresh every generation, may have men as its basis does *not* show that the divinities whose forms are unaltered by the lapse of ages, whose attributes are stolen to clothe the meaner creations, have the same original as their counterfeits. We are forced to the inevitable conclusion that mythology and history can mutually neither support nor destroy each other; that, in whatever form they may be fused together, they must be treated as distinct and independent. That Christmas is celebrated at the winter solstice is no proof that Christ was never born, but that the simple people found it the easier to remember the fact by the use of a long established holiday. The resurrection of our Saviour is neither proven nor falsified because Easter, occurring near the spring equinox, corresponds with an ancient heathen festival. That St. John's day, at the summer solstice, was thus placed in opposition to Christmas in chance accordance with the text "He must increase, but I must decrease,"[1] proves as little in regard to St. John the Baptist as does the Jewish New Year, at the autumnal equinox, for or against the development theory.

It may now be plainly seen that the prophets of the old testament and the Saviour of the new, may have been converted into solar heroes, without shaking the foundations of Christianity, and at present the chief exponents

[1] New Testament, John 3 : 30.

of the theory in our language are Max Müller and the Rev. Mr. Cox, men of most thorough learning and Christian reverence. The division is now upon an entirely different point; one party claiming that the *common* origin of humanity is proved by the accordance found in the myths; the other that the identity of natural phenomena is sufficient cause for the resemblances noted, even though mankind came from several *distinct* sources. The latter, favoring the views of a multiple origin of the race, has but few outspoken supporters; but is rather favored by Tylor, the most careful investigator of our years, and by Brinton, the author of a well known work upon the myths of the western continent. The former view, that of a common origin of the different races, seems now to be the prevailing one, and is supported by evidence, weighty, if not conclusive.

In all parts of both hemispheres, among races differing most widely in every distinguishing particular, we find the same methods of burial, the same ceremonies attending marriage, and like formulations of what seem to us arbitrary principles of law and morality. Not merely do we find that Solomon's song, is written upon the same general plan as songs of love among the Greeks, the Carmen Amœbaeum of Horace and the love passages in Frithiof's Saga; but in South America, Africa, Polynesia and China, we meet with like manifestations of the universal passion.[1] Not merely does the reformation headed by Buddha agree in its principles with the movement led by Luther, but in Persia, Peru and Aztec Mexico did the same causes, acting in a similar manner, produce like results. It seems scarcely probable that such coincidences can be the result of mere chance, and we can hardly claim them as the result of processes of thought necessarily inherent in man. The difficulty here is, that we find it impossible to conceive of the path which speculation must

[1] Lange's *Commentary :Song of Solomon.* N. Y., 1870.

take in a mind unbiassed by education, and can illy judge what would, or would not be, an inevitable course of thought. At present, therefore, a supporter of either conclusion need not fear that his arguments will be successfully attacked. But, however great the work which the new science has still before her; whatever vistas of the past she has yet to open, one great office has already been performed. We have found that all nations stand on a common ground, and may learn as the first great lesson of mythology, that, however widely their paths have diverged; however causes, long since forgotten, may have raised one race and degraded another; whatever distinctions, pride and power have made, to which weakness and humility have submitted, all men were born, if not free, at least equal.

PRINCE BISMARCK AND HIS POLICY.

By Arthur Bott.

[Read before the Albany Institute 16th January, 1877.]

Otto Edward Leopold von Bismarck was born at Schoenhausen on April 1, 1815.

There were six children, three of whom died when young. The survivors were, Bernhard; the third child, Otto, the subject of our sketch; and the youngest, a girl, Malvina.

His boyhood was spent at Kniephoff, Pomerania — an estate, which his father had inherited, and occupied in the year 1816.

Otto was the favorite child of his father, who nearly spoiled him by indulgence, but his education at school was according to the spirit of the times, more severe. In his boyhood he showed marked traits of character; he was truthful and sincere, but very reticent. He had great strength of will and an insatiable thirst for knowledge. He loved country life in all its phases. His mother exercised great influence in the formation of his character. She was of an earnest, somewhat cold nature; a quiet, but highly gifted lady, with a touch of religious fanaticism. She possessed unbounded ambition and great strength of will, and firmly believed in Prussia's manifest destiny. She regulated his studies, roused his ambition, and imbued him with a sense of his duties to the king, Prussia and the German nation. Napoleon I. had scarcely been conquered, Germany's humiliation was fresh in the nation's mind. The holy alliance was considered the only safeguard against a repetition of this degradation. These impressions received from the mother, were germs, which in late years, guided many of his actions.

It was during the time of the Schwarzroth-goldene unity-fanaticism, when Bismarck, in 1821, left the narrow circle of his home and entered the private school of Professor Plamann in Berlin.

The time of the rod, of which Bismarck speaks so often in later years, commenced. His mother, aware of the consequences of his father's indulgence, chose Plamann's school on account of its iron discipline. Bismarck speaks of this institution as a jail, which had robbed him of the purest joys of his youth.

He remained there until 1827, when he entered the Frederick Werder gymnasium, with Dr. Winkelman as private tutor.

Shortly after, he entered the pension of Prof. Prevost; then the school of Prof. Bonnell, who, with a classic simplicity and an earnest Christianity, combined clear intellectual capacities and a large pedagogic knowledge.

The chancellor of the German empire is as grateful and as much attached to Bonnell as was the youth Bismarck fifty years ago.

From 1829–31 he laid the foundation for a thorough knowledge of English and French, which accomplishments proved so serviceable to him in his diplomatic career. He excelled in history and Latin; he was endowed with a wonderful memory, which enabled him to fill his mind with knowledge of every description.

In 1832 he went to the University at Gœttingen to study law. It was the wish of his father to educate him for the *higher administration.* He distinguished himself at the university as a quick tempered, skilful duelist, an accomplished drinker, a reckless, arrogant Prussian junker (aristocrat), who was more at home on the dueling ground than in the lecture room.

But what he left undone at the university he made up by private study. He passed his examination in 1835; became ascultator, and practiced law at the city court at Berlin. In the winter of 1835–6, he was introduced at the court, and met there for the first time Prince William (now emperor), whose iron minister he afterwards became. His athletic figure created a sensation. Prince William asked him jocosely, "whether the law selected its votaries by measure, as did the imperial guards."

In 1840 he was transferred to the administration at Aachen, which had for its president Count Arnim-Boitzenburg. His intercourse with Englishmen and Frenchmen was very extended. In the following year he was transferred to Potsdam, where he served his year in the Garde-Hunters.

The time of trial now commenced. His father had mortgaged the family estate heavily, and the sons were called upon to support the family. Otto was transferred to the administration at Greifswalde, to be near the agricultural academy at Eldena, in order to prepare himself for his future vocation — agriculture.

The united efforts of the brothers, to save the family estate, were crowned with success. Both brothers shared in the administration, and their mutual relation, which terminated in 1844, was of the most affectionate nature.

During this time Bismarck developed his taste for agriculture and hunting, which now gives him his purest pleasures and surest recreation. Whatever his opponents may say of him, all agree that he is a man of the warmest sympathies, and that those in need find in him an ever ready friend.

Oct. 30, 1844, his only sister Malvina was married to a friend of his youth, Herr Oscar von Arnim. One year later his father died; the family circle was broken up; the estate divided, and Bismarck received Schoenhausen as his portion of the inheritance.

But a restless spirit like his could not be satisfied with a life of comparative inactivity during a great part of the year; he longed for a more active life. Two symptoms indicated this; he began to politize, and wished to get married.

Prince Bismarck found plenty of material for political cogitations. Since the July revolution in France, and the outbreak in Poland, the peace-dream of the continent had been shattered, and many indications showed, that a new epoch would require new conditions and new men, and that new questions and new interests would spring into the foreground. An era of industry, a personal ambition, in short the epoch of individualism had arrived and offered battle to the existing authority. These signs showed themselves first in France. The last remnants of the old monarchical traditions fell with the last of the Bourbons, and with them feudal aristocracy. Louis Philip of Orleans, was the *citizen king.* Under him France enjoyed a liberty and prosperity, which might well cause the envy of Germany. An industrial splendor, wealth, and an extended commerce brought France into successful competition with English industry. The old arrogance towards its neighbors showed itself in the same ratio as the nation's wealth increased. The campaign in Belgium, the acquisition of Algeria, whose cultivation swallowed up millions, the desire after the Rhine, showed conclusively, that the citizen kingdom rested upon treacherous soil.

In Prussia, matters were in a transition period; while its foreign relations were not imposing yet they were tolerably respectable. Central Europe, by reason of the holy alliance, was safe from aggressions from without. The diet of Frankfort curbed the ambition of the individual state through the power of the whole nation. This was the policy of the European equilibrium, whose founders were Metternich and Nesselrode, and whose champion was Nicholas I., of Russia — the symbol of absolute monarchy in Europe, which had been inaugurated by Louis XIV. During the czar's visit in Berlin, in 1843, he was the object of admiration and reverence of all absolutistic circles, and an object of hatred and fear of the liberal element of the people.

The increasing cry after a constitution, more earnestly pressed by assemblies and municipalities; the signs in the religious world; the holy of coat Trier, German catholicism; the growing discontent of the workingmen; a flood of revolutionary pamphlets; the new Polish insurrection under Mieroslawsky; the open revolt at Krakau; the open letter of Christian VIII. of Denmark — all these events furnished plenty of material for Bismarck's political predilections.

The ministry of Eichorn was unable to stem the tide of radicalism, which slowly but surely came across the Rhine. A royal decree of Feb. 13, 1843 called the United Diet (Landtag), of which Prince Bismarck was a member. Before he appeared upon the battle ground he married Johanna von Puttkammer, of one of the oldest houses of the Prussian nobility. This happy union brought him that freshness of heart and mind, for which he had longed.

There were three parties in the united Landtag:

1. The *royalistic party*, which recognized in the February patent the utmost limit of concessions.

2. The *party of parliamentary monarchy*, which aimed at a constitution, based upon the February patent, and which advocated the dignity of the crown and the fulfillment of the just demands of the people; and

3. The *radical party*, which aimed at a diminution of royal prerogatives.

Bismarck belonged to the second party. His motto was, a nation without a strong administration is lost; to protect royalty, is to strengthen the nation, and give it that freedom, under whose wings every citizen can securely live and enjoy his own. In advocating these principles he made bitter enemies in both parties, whose animosity increased in intensity, as his iron will and clear logic gained ascendency.

The 18th of March 1848 approached. The stormflood of rebellion came from Paris; the Orleans dynasty had fled; Lamartine became president of the republic. Outbreaks in Vienna and Munich followed. Emperor Ferdinand of Austria abdicated in favor of his nephew, Francis Joseph. King Louis of Bavaria placed his sceptre in the hands of his son Maximilian. On the 18th day of March, rebellion broke out in Prussia. The principle of legitimacy on the continent seemed to totter.

During this time Bismarck maintained, that the people could only be free and prosperous by securing a strong king, hence he was in direct antagonism with the spirit of the times, while he was forced to admit, that behind all the mad chimeræ of those times there was a strong power of the people, a desire for independent government; and he hoped in his own time to build upon these germs a new era, clear, great, and German within and without — in short give to the German nationality that recognition among the nations of the world, to which its inherent merit entitled it.

The revolution in Prussia continued; new ministries succeeded each other in quick succession.

Bismarck followed the intellectual and material course of events, and worked faithfully to create in Berlin a loyal party, true to the king, with the *Neue Preussische Zeitung* as its organ.

The socialistic tendencies of 1848 killed themselves by their excesses. The national parliament divided itself.

The refusal of taxes; the bloody fight of the workingmen in Berlin against the citizens; Wrangel's entrance into Berlin, and the state of siege ended the reign of the sovereign people.

In December 1848 Bismarck appeared in Berlin as representative of Brandenburg.

The old constitution placed the Prussian state upon two powers, viz:

The crown as the sanctioning and executive power; and the united representatives as the consulting, agreeing and vetoing power. Electors were subjected to property qualifications, and the indirect election was filtered by political opinion.

This constitution was disliked by the people, but Bismarck sustained it as it had emanated from the king, and promised to be more stable than the changeful tendencies of socialism.

Outside of the fatherland two events had occurred, which changed the political aspect of Europe. The Holy Alliance had partly been rent. Its chief bearer, Metternich, had retired, and the youthful emperor had inaugurated a new policy. The French republic was near its end. Louis Napoleon had been elected its first president, and Cæsarism loomed up in the distance. On January 28, 1848, Christian VIII., of Denmark died, and his successor, Fred. VII., promulgated immediately after his ascension, a constitution, which made Schleswig-Holstein Danish.

Bismarck watched with sad forebodings not only the state of affairs in Prussia, but also abroad.

The assembly opened in Berlin, Feb. 26, 1848. His own party received him with enthusiasm. The bloody democracy had lost its power; many of his most bitter opponents like Virchow, Auerswald, etc., sided with him.

When Bismarck appeared to friends and foes alike as changeful in his political opinions, it was owing to his quicker perception of principles which were opposed to his own ideas at the time; and in all such cases the interests of the fatherland were paramount to his own. His one aim was the welfare of the crown and nation, and often, when circumstances required it, he seemed more liberal or reactionary than he actually felt, hence his double character in 1849.

He favored the acceptance of the constitution which was obnoxious to him, and opposed with all his energy the war for the liberation of Schleswig-Holstein. The reasons were obvious. While the continent was out of joint and belligerent, Louis Napoleon was anxious for war, that he might seize the purple; which he accomplished by intrigue, three years later. Germany was divided; revolutions in Baden and Saxony; the Prussian army disorganized, the treasury almost empty. Doctrines and phrases could not do the work of bayonets and bullets. The German imperial crown could only be gained on the battle field.

The offer of that crown by the Frankfort Diet showed conclusively the faith of the German nation in the house of Hohenzollern. When in later times it needed two great historical epochs to break the individualism of princes and people to unite them, can any one believe that such a union could have been accomplished in 1849? Neither the Frankfort nor Erfurt parliaments could understand that unity could only be thought of, when the command of the army and the direction of a foreign policy rested in one man's hands.

The so-called Union Parliament opened in the spring of 1850.

Since 1840 Prussia had demanded of Austria, as an act of self preservation, an alternate *presidium* at the diet in Frankfort.[1] The aim of such a demand was, Prussia's desire to exercise an equal influence in Germany's affairs.

[1] The Diet at Frankfort was composed of seventeen envoys, presided over by the representatives of Austria. There were, however, thirteen states, exclusive of the free cities, represented in the last period of the Diet's existence. The diet was so constituted that each of the following states, or combination of states, had one representative:

Austria, Prussia, Bavaria, Saxony, Hanover, Würtemberg, Baden, Electorate of Hessia, Grand Duchy of Hessia; Denmark for the Duchies of

Hanover, on the 27th of February, broke loose from the treaty with Prussia and its North German policy, and went over to Austria.

On the 26th of April, Austria demanded a parliament in Frankfort, a measure detrimental to Prussia's interest. Prussia protested.

The smaller states, to paralyze Prussia and Austria, formed a union headed by Herr von der Pfordten in Munich, and von Beust in Dresden. The Prussian embassador was recalled from Frankfort. Most of the German states leaned towards Austria. A conflict and appeal to arms between the two rivals seemed inevitable. The disorders in Hessia added to the old jealousy between Hohenzollern and Hapsburg.

The Prussian army was mobilized against Austria. The chances of success were in favor of the latter.

Russia called a conference at Warsaw on October 15th, to bring about a reconciliation. Austria again refused to Prussia a co-presidium at the Diet.

Emperor Nicholas saw the Holy Alliance endangered, and the European equilibrium disturbed. Two Austrian army corps were ready to march into Prussia at a moment's warning. Emperor Nicholas demanded a conference at Olmütz; Prussia assented, and was humbled. Bismarck

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Holstein and Lauenburg; the Netherlands for Limburg and Luxemburg the Duchies of Saxe-Meiningen, Saxe-Coburg-Gotha and Saxe-Altenburg, Brunswick and Nassau, the two Mecklenburgs (Schwerin and Strelitz), Oldenburg, Anhalt and two Schwarzenbergs (Rudolstadt and Sondershausen), Lichtenstein, Reuss, Schaumburg Lippe, Lippe Detmold, Waldeck and Hesse Homburg; the free cities, Lubeck, Frankfort, Bremen and Hamburg.

The votes were equal, the sittings secret.

On important occasions the assembly was resolved into what was called the *plenum*, in which a greater number of votes were assigned to the chief states, and the total number of voices was then increased to seventy. In these cases a majority of three-fourths was necessary for any question to be carried.

Ambassadors were accredited to the Diet.

defended the Olmütz policy, while in his inmost soul he cursed it.[1]

On the strength of the most excellent authority he knew that the Prussian army was no match for the Austrian. But this state of things cured him of one illusion, *i. e.* that *Austria* could be the *German representative power*, and that Prussia alone could be the standard bearer of German unity. Henceforth he had only one idea, chimerical as it seemed at first — to humble and isolate Austria; to fight Romanism and turn the smaller German states to seek for themselves unity of Germany through Prussia.

In his defence of the Olmütz conference, public opinion pursued him with bitter hatred, and especially was the Prussian nobility attacked in him.

"Ich bin stolz darauf ein Preussischer Junker zu sein." At this time Bismarck's career underwent a great change; i. e. he became diplomatist. Prussia's representation in Frankfort had to be guided by stronger hands since her humiliation at Olmütz through Austria. She needed a representative, who was acceptable to Austria; who could manage Prussia's interests with delicacy and firmness and who understood how to defend the rights of the crown and nation.

King, ministry and the majority of the people felt this humiliating position; especially was the king's brother, the present emperor, desirous of reorganizing the army, and making it a match for any on the continent.

Bismarck was elected embassador to Frankfort; all felt that in his hands Prussia's interests would be safe, while he, in defending the Olmütz conference, was a *personagrate* at the court of Vienna.

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[1] A circular of Prince Schwarzenberg says: "His majesty the emperor thinks it his duty to comply with the desire of the king of Prussia, so modestly expressed."

The danger of his country had made him a politician, the day of Olmütz a diplomatist.

Diplomacy, up to this time, had been a kind of a mystery, something like the Holy Inquisition or the Council of Ten at Venice.

European diplomacy originated in the old Italian merchant wisdom of the Medici, and was carried on with all the serpent-like distrust of those times. To play jugglery with God's great gift of speech, to lie with the greatest appearance of truth, was diplomacy.

The general condition of things at the beginning of this century found in the Diet a fertile soil for this kind of diplomacy. The policy of the European cabinets, since 1815, was merely a defensive system against restless France, which since the fall of the first Napoleon up to 1851 had changed its rulers and form of government four times. This defensive system found expression in the Holy Alliance, the policy of which was defense against France, protection from rebellion at home, and the preservation of an absolute monarchy.

Faulty as this system was, it gave security to the states, although it was antagonistic to the growing culture of the people. Metternich's unchangeable states-maxim was, full accord with Prussia in all German questions at home and abroad.

This system, changed in 1848, was a mere shadow in 1850, and was buried on the 31st of March with Metternich's resignation. The then emperor of Germany had become emperor of Austria. Francis Joseph was surrounded by different influences; a Schwarzenberg, the bearer of Ultra-Catholicism, formed a cabinet. The experiences gained during the Hungarian revolution, which had proved the utter unreliability of the non-German races, dictated a new policy, which found its point of gravity in the German policy at the expense of Prussia.

The Camarilla at the court of Vienna was against the development of the people, against Protestantism — the emperor's mother being the most pronounced advocate of the Jesuits and Redemptorists.

One man hated Prussia most intensely, not as Austrian or Romanist, but from family instincts, and that man was Minister Schwarzenberg, whose ancestor, Count Adam von Schwarzenberg, had been sentenced to death by the great elector of Prussia.

After this catastrophe the Schwarzenberg family went to Austria, became rich, were elevated to the highest nobility, and recompensed all favors of the Austrian court by the most bitter hatred against Prussia.

The situation at Frankfort, when Bismarck appeared there, was not very favorable to Prussia. Everybody snubbed Bismarck, except the Praesidial embassador, Count Thun Hohenstein, who saw in him the defender of the Olmütz policy — a true adherent of Austria. His position was a very difficult one, but he was equal to the occasion. He visited the neighboring courts of Darmstadt, Biebrich and Carlsruhe, wrote almost daily confidential messages to his friends, especially the Adjutant General von Gerlach, at Berlin ; exposed anonymously all the follies of his adversaries, created a public opinion favorable to his plans, and worked especially to convince Prince William (present emperor) that the days of Olmütz must be ended.

The following is a letter, written by him at this time to ———

"Frankfurt, 18*th May*, '51.

"Frankfurt is wretchedly wearisome. I am so spoilt with having so much affection about me, and a great deal to do; and I now first perceive how unthankful I have have been toward many people in Berlin — for I will not take you and yours into the question. Even the coolness of fellow-countrymen and party associates I had in Berlin, is an intimate connection compared with the relations suspicious espionage. If one had any thing indeed to detect or to conceal! The people here worry themselves about the merest trifles; and these diplomatists, with their important nothings, already appear more ridiculous to me than a deputy of the second chamber in his full-blown dignity. Unless outward events take place, which we clever members of the Diet can neither guide nor predetermine, I now know accurately what we shall have done in one, two, or five years, and could bring it about in twenty-four hours, if the others would for a single day be reasonable and truthful. I never doubted that they all made soup with water, but such a simple, thin water-gruel, in which one cannot see a globule of fat, astonishes me! Send me Justice X. or Herr Von?arsky hither from the toll-gate, when they are washed and combed, and I will lord it in diplomacy with them. I am making enormous progress in the art of saying nothing in a great many words. I write reports of many sheets, which read as tersely and roundly as leading articles; and if Manteuffel can say what there is in them, after he has read them, he can do more than I.

"Each of us pretends to believe of his neighbor that he is full of thought and plans, if he would only tell; and at the same time we none of us know an atom more of what is going to happen to Germany than of next year's snow. Nobody, not even the most malicious skeptic of a democrat, suspects what quackery and self-importance there is in this diplomatizing. Well, I have railed long enough, and now I will tell you that I am very well. Yesterday I was in Mainz: the neighborhood is lovely. The rye is in full ear, although it is infamously cold at night and in the mornings. Excursions by railroad are the best here. One can reach Heidelberg, Baden-Baden, Odenwald, Homburg, Soden, Weisbaden, Bingen, Rüdesheim, and one makes here—being, in fact, nothing more than mutual

Neiderwald comfortably in one day, stop five or six hours, and return here in the evening. As yet I have not gone much about, but shall do so, that I may take you about when you come. Rochow started yesterday for Warsaw, leaving at nine o'clock in the evening; the day after to-morrow he will be there, and probably back in a week. As to politics and people, I cannot write much, as most of the letters are opened here. When they know your address or mine, and your hand writing on your letters, they will very likely find out they have no time to read family letters."

The unity of the Diet was merely dictated by self preservation of the smaller states, and was based upon the competition of Prussia and Austria.

United, the small states could exist; a connection with either Prussia or Austria could give them some importance, which would enable them to co-reign over Germany.

The only bond of union was the custom-union; it was the regulator of the Diet, and touched the most vital interests of all the states.

The storm burst forth at last. In October, 1852, the members of the Holy Alliance met in Warsaw for the last time. The first electric shock already made the gentlemen in Frankfort tremble. By a plebiscite Louis Napoleon became emperor of France. The bloody play of cannon ended the republic. The emperor's marriage with Eugénie ván Montijo indicated an alliance of the empire with Jesuitism: he became a Romanist of the purest water. He broke on December 2d with all liberal elements, which from henceforth became his enemies. He could only hold himself by his bayonets, Rome and the clergy. The conscience of France was governed from the Vatican.

As an instance of the animosity of all the states against Prussia, one example may suffice. On the 24th of April an agreement was made between Saxony and Austria, by which Saxony bound herself not to allow the Prussian government, for twenty-five years to come, to establish a railroad connection at Reichenberg, which act was a great commercial disadvantage to Prussia.

The Holy Alliance was buried in 1854, during the Crimean war; Russia was defeated; Emperor Nicholas died March 2, 1855; Alexander II. made peace. Napoleon was victor. The tone of France against Prussia now became somewhat overbearing. Napoleon turned his eyes towards the Rhine, and the French journals discussed the importance of a rectification of the frontier and the treaty of 1815, while at the same time there was a growing intimacy between France and Russia, which could not be very agreeable to Prussia and aroused trouble in Austria.

In June, 1855, Bismarck visited the Paris exhibition, and began herewith his intimate relations with the court of France, thenceforth continued to the day of Sedan, and which brought him the repute of being a scholar and imitator of the policy of Napoleon III.

On February 25, 1856, the Paris conference came to an end, and Napoleon emerged from it with power and glory, making him the most powerful sovereign in Europe, and, by which, he arrogated to himself the dictation of his commands to the European courts.

This policy showed itself in his throwing down the gauntlet to those powers, whom he considered as instrumental in restricting and subduing France in 1815.

Austria, whose intentions of a hegemony in Europe were too plainly to be seen during the Crimean war, was considered next to Russia, Napoleon's most dangerous neighbor; hence her influence in her southern provinces had to be lessened, and an enemy created in her rear, who was bound to Napoleon by ties of gratitude. That state was Italy.

All the actors played as yet behind the scenes and only a few favored ones were initiated.

Bismarck visited Paris in the spring of 1857, and held long consultations with Napoleon. The world will never know what transpired between the two, but that Prussia's power and German unity may have loomed up before Bismack in the future, may safely be assumed.

It is fashionable to-day, in France, to represent the Prussian government as having meditated for half a century a war of revenge and conquest, slowly brightening their arms and training a succession of generations for the decisive hour of combat. This is a fallacy.

The swords of Blucher and Scharnhorst were sheathed in 1815. Even the adoption of the needle gun in 1847 was only an accident, or rather a scientific experiment; and in 1848 and 1849 Prussian troops did not shine with marvelous éclat in the war of the Duchies, and were even miserably held in check by the undisciplined bands of the insurrection of Baden and Posen.

It was only the mobilization attempted during the Italian complications, which opened their eyes to all the grave inconveniences and incoherencies of the organization till then in force. Two men, Von Moltke and Von Roon, joined with the prince regent in remodeling the system from the very bottom, and produced, at the end of six years an armed force, entirely new, powerful and invincible.

In August, 1857, Von Moltke became chief of the great general staff. The next year William I. became king of Prussia, and with the change in the ministry, the Olmütz policy fell to the ground.

In the king's address to his ministry one sentence was especially emphasized: "I will never allow religion to be the cloak for politics."

The year 1859 brought the Italian war, and we find

Bismarck as embassador in Petersburg. Russia leaned towards France: that tendency had to be neutralized, and Bismarck was the man to accomplish that object.

Napoleon, in promoting Italian unity, foresaw not its consequences. Italy was the central point of the Catholic church: the Vatican its spiritual head — its natural ruler.

The Latin race, through the strength of its hierarchical political regimen, had gained and maintained itself in power and rule. Elizabeth and William of Orange, Luther and Calvin, the gradual growth of the north and middle German municipal life, could but curtail the power of the Latin race; but up to 1858 that race had not lost anything of its preponderance in European politics; neither had the successor of Peter diminished his authority as head of Catholicism.

It was reserved for Napoleon III. to dig the grave of Catholicism with his own hands.

The French nation had been, since the days of the Medici, the bearer of the Romanistic power in western Europe.

Austria, in its total hierarchic life, was Rome's spiritual domain.

Italy, cut up and dissatisfied, up to 1858 represented the conscience of Romanism, and found in Lombardo Venetia the strongest bulwark of the Roman Catholic principle.

The unity of Italy was a national necessity, dictated by the spirit of the times, but inasmuch as Napoleon, with sword in hand, gave to that necessity a living form, he became the head of Italy's rebellion against Rome's authority, and — the Latin race itself.

With Austria's defeat at Villa-franca fell the mightiest shield of the Vatican against modern society, against the free rights of self-determination of the European peoples. With Italy's unity, Napoleon robbed the Vatican of its old possessions, and degraded the pope from a temporal sovereign to a Roman bishop, who was only the head of the Catholic church, and whose power from henceforth rested merely in the faith of the Catholic nations.

Napoleon, without knowing it, had raised the German unity question, whose deadly enemy he was.

Magenta and Solferino were the first building stones of German unity.

That Napoleon had some undefined suspicion of his blunder may be inferred from the fact, that he left a French army at the disposal of the Roman curia. He kept the new kingdom in a state of dependence, and was always ready to march with an army and correct the work of his own hands.

On April 1, 1859, Bismarck was recalled from Frankfort and sent to Petersburg as embassador.

The observations of his Frankfort experiences were expressed in the following conclusions: "All measures at the Diet are carried by Austria and its smaller states to the manifest disadvantage of Prussia. The curtailing of Prussia's power seems to be the magnetic needle of all their actions."

Napoleon III. descended to the plains of Lombardy: Austria was vanquished at Magenta and Solferino, and Russia could enjoy its first revenge on the ungrateful Hapsburg, who had betrayed it before Sebastopol.

The declaration of peace at Villa-franca made Napoleon the political pontifex of Europe, and Prussia was the next power on whom Austria's fate was to be repeated.

To meet the emergency, which seemed to every clear-sighted statesman inevitable, the reorganization of the army was at last decreed (merely decreed) on July 4, 1861.

Prussia's direct gain by the Franco-Austrian war was, an estrangement of some of the smaller German states from Austria and a firmer attitude of Prussia in the Diet.

But Austria showed considerable spite towards Prussia, and an open rupture was only avoided by the meeting of the two sovereigns at Bavaria's invitation at Teplitz. At this time Bismarck writes as follows:

"St. Petersburg, 22*d August*, 1860.

"I am quite excluded from home politics, for with the exception of newspapers, I only receive official statements, which do not give me the groundwork of things. According to these, we have promised nothing definite at Teplitz but have made our support of Austria dependent upon that practical demonstration of her good-will towards us in German politics; when this has been done, she may reckon on our gratitude. I should be very content with this; and if we only see the Vienna soap in a lather, we should be glad to return the service. Certainly the indirect accounts we receive from other courts sound otherwise. According to these, if true, though we have not concluded any guarantee treaty, we have, at any rate, bound ourselves verbally to assist Austria, under all circumstances, should she be attacked by France in Italy. Should Austria find it necessary to act on the offensive, our consent would be requisite, if our coöperation is to be anticipated. This version appears more unprejudiced than it would, in fact, be. Austria having security that we should fight for Venice, she will know how to provoke the attack of France. It has been asserted that since Teplitz, Austria has come out boldly and defiantly in Italy. Viennese politics, since the Garibaldian expedition, desire to make things in Italy as bad as they can be, in order that if Napoleon himself should find it necessary to declare against the Italian revolution, movements should commence on all sides and former conditions be assimilatively restored. This reckoning with and upon Napoleon may be very deceptive, and, it would seem as if, since Teplitz, it has been given up, and there were hopes of attaining results by opposing Napoleon. The restless, passionate character of Austrian politics endangers peace in both ways. What will the chamber say to Teplitz — to the organization of the army? All sensible men will naturally agree with government as to the latter. But the influence of foreign politics can first be estimated, when it is known *what the meaning of Teplitz really is.* A well-informed but somewhat Bonapartist correspondent writes to me from Berlin, 'We were prettily taken in at Teplitz by Viennese good-humor; sold, for nothing, not even a mess of pottage.' God grant that he errs in this! In speaking of the Bonapartists, it occurs to me that some kind of general rumors reach me, that the press, *National Verein*, *Magdeburger*, *Ostpreussische Zeitung*, carry on a systematic war of calumny against me. I am said to have openly supported Russo-Franco pretensions respecting a cession of the Rhine province, on the condition of compensation nearer home; I am a second Borries, and so on. I will pay a thousand Fredericks-d'or to the person who will prove to me that any such Russo-Franco propositions have ever been brought to my knowledge by any one. In the whole period of my German residence I never advised any thing else than that we should rely on our own strength, and in the case of war, upon the aid of the national forces of Germany. These foolish geese of the German press do not see that in attacking me they are losing the better part of their own efforts. I am informed that the fountain-head of these attacks was the court of Coburg, in a writer who has personal spite against me. Were I an Austrian statesman, or a German prince and Austrian reactionist, like the Duke of Meiningen, our *Kreuzzeitung* would have protected me as it has him. The mendacity of these assaults is unknown to some of our political friends. As I am, however, an old member of their party, entertaining particular ideas upon certain points, well known to the writer to his misfortune, I may be slandered to their hearts' content. I hear of the whole affair principally from the officious advocacy of the *Elberfeld Zeitung*, which is sent to me. There is nothing like an inquisition, and friends, who long have partaken of the same cup, are more unjust than foes. I am satisfied. One ought not to rely on men, and I am thankful for every breath which draws me inward."

In a conversation with the Austrian embassador, Count Karolyi, Bismarck said: "The centre of gravity of Austrian politics ought to rest in Ofen" (the Hungarian capital). This sentence received wings: it was repeated at all courts, was in the mouths of all diplomatists, and gave the court of Vienna food for reflection.

Neither the court of Berlin, nor the two houses, nor the diplomatists understood him, so that he could cry out with the philosopher Hegel: "Of all my scholars only one understood me, and he misunderstood me."

With the London treaty of October 31, 1862, between France, England and Spain, Bismarck saw his time slowly approaching. Napoleon, busily engaged in Mexico, would find neither time nor opportunity to take advantage of Prussia's internal dissensions, which to Bismarck's clear conceptions were merely the prelude to the new order of things, which must lift Prussia to strength and greatness.

May 23, 1862, Bismarck was transferred from Petersburg as embassador to Paris, one of the boldest and most sagacious movements in modern diplomacy. The advantages derived from this position were incalculable. None of his letters indicated any of his experiences, but after events clearly demonstrated that he most carefully studied Napoleon and his policy.

Matters at Berlin hurried on to a crisis. The government needed a strong arm to carry through its measures; Bismarck was cited to Berlin, to take the premiership of the ministry. He answered the king, "Your majesty has called me into your service, I shall do my duty," and never entered a man upon a position at a more critical time.

Bismarck's liberal opponents, the enemies from below, believed that the reactionary junker of 1848, the downright Prussian of Erfurt, the man, who made himself hated in Frankfort and beloved in Petersburg — who had just graduated at the school of intrigues at Paris — that this man must be a despot, who would kill the constitution. Bismarck's opponents from above, expected that he would kill the constitution and cause a reaction. Both parties reasoned, that matters could not be any worse, and allowed him to take his course.

He entered upon his office with strong confidence. He conferred with many of the hostile party leaders, liberals, as well as progressists, who desired the well-being of Prussia and Germany; but he succeeded in winning only very few. Rigid party doctrines, an unvanquishable suspicion kept many from joining him; but his tone towards his opponents was that of conciliation.

On the 29th of September, 1862, he announced the withdrawal of the budget for 1863, "because the government considered it its duty not to allow the obstacles towards a settlement to increase in volume." He then announced his intentions — his aims — as clearly as he dared. "The conflict has been too tragically understood, and too tragically represented by the press; the government sought no contest. If the crisis could be honorably surmounted, the government would gladly lend a hand. It was owing to the great obstinacy of individuals that it was difficult to govern with the constitution in Prussia. A constitutional crisis was no disgrace, it was an honor. We are, perhaps, too cultured to indorse a constitution: we are too critical. Public opinion changes; the press was *not* public opinion; it was well known how the press was upheld. Germany does not contemplate the liberalism of Prussia, but her power. Bavaria, Wurtemberg and Baden might indulge liberalism, but they are not, therefore, called upon to play the part of Prussia. Prussia must hold her power together for the favorable opportunity, which has already been sometimes neglected. The great questions of the day were not to be decided by speeches and majorities, but by iron and blood."

The chamber answered by the resolutions of October 7th, by which all expenditure was declared unconstitutional, if declined by the national representatives; to which Bismarck replied: "According to this resolution, the royal government cannot, for the present, anticipate any result from the continuance of its attempts to arrive at some settlement; it must rather expect from any renewal of the negotiation a heightening of party differences, which would render any understanding in the future more difficult."

At the close of the session of the Diet, October 13th, Bismarck said: "The government is perfectly aware of the responsibility which has arisen from this lamentable crisis, but at the same time, it is also observant of the duties it owes to the country, and in this finds itself strengthened to press for the supplies necessary for existing state institutions and the furtherance of the common weal, being assured that at the proper time, they will receive the subsequent sanction of the Diet."

After assuming the ministry in December, 1862, Bismarck entered upon negotiations with Austria. In the famous circular dispatch of the 24th of January, 1863, he says:

"In order to bring about a better understanding of the two courts I took the initiative in the form of negotiations with Count Karolyi, in which I brought the following considerations under the notice of the imperial embassador. According to my convictions our relations to Austria must unavoidably change for the better or the worse. It is the sincere wish of the royal government that the *former* alternative should arise, but if we should not be met by the imperial cabinet with the advances we could desire, it will be necessary for us to contemplate the other alternative, and prepare for it accordingly."

"The fact that Prussia did not seek for any advantage in consequence of the difficulties of Austria in 1859, but rather armed to assist Austria in need, clearly shows the results of the former more intimate relations. But should these last not be renewed and revivified, Prussia would, under similar circumstances, be as little debarred from contracting an alliance with an antagonist of Austria, as, under opposite circumstances, from forming a faithful and firm alliance with Austria, against common enemies. I, at least, as I did not conceal from Count Karolyi, under such circumstances could never advise my gracious sovereign to neutrality. Austria is free to choose, whether she prefers to continue her present anti-Prussian policy, with the leverage of the coalition of the central states, or seek an honest union with Prussia. That the latter may be the result, is my most sincere desire. This can, however, only be obtained by the abandonment of Austria's inimical policy at the German courts," etc.

"I indicated that the passing once the border of legitimate competency by resolutions of the majority, would be regarded by us as a breach of the federal treaties, and that we should mark our sense of the fact by the withdrawal of the royal embassador to the Diet, without nominating any successor, and I drew attention to the practical consequences likely to ensue upon such a situation in a comparatively short time, as it would naturally occur that the activity of an assembly, in which, from just causes we no longer took part, would be regarded by us as unauthoritative on the whole business sphere of the Diet."

In the summer of 1863, Bismarck accompanied his king to Carlsbad, and thence to Gastein, when Austria proposed reorganization on the *federal principle*, as opposed to Prussian unionistic efforts.

King William declined to attend the princes's congress at Frankfort, where the fundamental principles of the Austrian project were accepted. Their compact proved fruitless. Nothing was possible in Germany without Prussia.

Bismarck, in his royal reply to the members of the princes's congress promulgated a series of "preliminary conditions," as to the part Prussia might take in further negotiations. He demanded,

1. The veto of Prussia and Austria upon every federal war not undertaken in resistance of an attack upon federal authority.

2. The entire equality of Prussia with Austria in the presidency and government of federal concerns.

3. A national representation, not to consist of delegates, but of directly chosen representatives, in the ratio of the populations of single states, the powers of which, in resolution, should, in any case, be more extensive than those in the project of the Frankfort reform act.

As a plea for this condition he inserted in his report to the king, that the interests and requirements of the Prussian people were essentially and indissolubly identical with those of the German people whenever this element attained its true construction and value, Prussia never need fear to be drawn into any policy adverse to her own interests.

This firm attitude saved the future of Prussia, and also that of Germany.

War seemed imminent and war came; not between Prussia and Austria, but Prussia and Austria against Denmark. The Schleswig-Holstein question was managed with ardor, audacity and incomparable acuteness.

On the 29th of September, 1863, the council of the empire of Denmark promulgated a decree of a common constitution for the whole monarchy, which was nothing more nor less than an incorporation, and a Dananizing of Schleswig-Holstein. On Nov. 13th, the Diet of Copenhagen sanctioned this decree, and two days afterwards King Frederick VII., of Denmark, was a corpse. In the meantime the hereditary Prince Frederic of Augustenburg had proclaimed himself duke of the two provinces, while the Danish ministry at Copenhagen gave the crown to Christian IX. under the condition, to Dananize Schleswig-Holstein and incorporate them into the monarchy.

How Prussia succeeded in inducing Austria to draw the sword for Prussia's interest in contradiction to her entire previous policy, is impossible to tell, suffice it to say, that Austria and Prussia did fight together; that Prince Frederick Charles planted the Prussian standard on the walls of Düppel in April, 1864; Bismarck renounced, on May 18th, the conditions of the London protocol; on May 28th, Austria and Prussia demanded in London the complete separation of the Duchies from Denmark. June 25th, the London conference adjourned without reaching any result, and on June 29th, Gen. Herworth took the island of Alsen. The war was ended.[1]

I shall pass over the time from autumn 1864, to May, 1866. "It was in the midst of dark intrigues, and of nego-

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[1] "In 1865, Bismarck visited Napoleon at Biaritz, when he disclosed to him some of his projects. Napoleon, resting on the arm of the author of "Colomba," whispered from time to time into the ear of the academician senator these words: "He is crazy." Five years later the dreamer of Ham gave up his sword to the crazy man of the Mark."

tiations more or less regular, of preparations for war and of continual exchange of notes, of parliamentary conflicts and of almost continual daily combats with the old fogies of the court, that the first six months of the year of 1866 passed for Bismarck, and rarely has a statesman lived through a more troubled period. "The waves of events first cast him ashore, then threw him back again and seemed to remove him farther than ever from his goal." Never in all his public career has Bismarck shown greater intellectual resources; never was he more fruitful in expedients. He moved step by step in every political question; every move was carefully weighed and balanced; every succeeding measure most skillfully prepared."

Before the close of 1865, Bismarck had become firmly convinced that Austria had returned to the central state policy, the advocate of which was Freiherr von Beust, who saw the salvation of Germany in the hegemony of Austria. This latter power, smarting under the defeat of her policy in Schleswig-Holstein and encouraged by Saxony, Hanover and Hessia, prepared for war by mobilizing her army in Venice.

As an offset, Prussia concluded a treaty with Italy, and contrary to the king's inclinations ordered the mobilization of her own army March 28th, 1866.

While negotiations for a peaceful settlement were still pending, with every prospect of success, an attack was made on the life of Prince Bismarck, by Carl Blind, which opened the eyes of the king at last, who now became convinced that peaceable means were futile, and that the sword alone could settle the controversy.

On May 8th, the whole Prussian army was called under arms. On June 12th, the Diet of Frankfort declared war against Prussia. Prussia declared its withdrawal from the Diet. War commenced June 15, 1866. On July 3d, the battle between Hapsburg and Hohenzollern ended.

When the news of the Prussian victory reached the Vatican, Cardinal Antonelli exclaimed in terror: "The world is out of joint." A cry of anguish came from the whole Roman camp.

Bismarck's position after the Prussian-Austrian war, was an exceedingly difficult one. There were dangers ahead which neither the genius of Von Moltke, nor the bravery of the army, nor the masterly leadership of its generals could overcome. It needed the consummate skill of Bismarck's statesmanship.

The Scaninavian North hated Prussia.

Austria's watchword was "Revenge."

France was poison and gall.

England could not forget the occupation of Hanover.

Russia was a doubtful ally.

A new war had to be prevented and yet the fruits of victory to be reaped.

The treaty of peace of Nikolsburg solved the problem.

Benedetti stepped forward and proposed French intervention, which could not be refused.

Venice was ceded to Napoleon, and by him transferred to Victor Emmanuel.

Napoleon desired a recompense for his magnanimity in not throwing an army across the Rhine. This demand had been feared in Prussia and expected in South Germany.

While the peace of Nikolsburg had disclosed Austria's and its allies' weakness, it had showed also the weakness of France. Napoleon's army was still in Mexico, and therefore unavailable for active operations; the doubt whether direct interference would not reconcile the contending parties was a further reason for delaying matters, which proved fatal to him afterwards.

Prussia's victory had astounded Napoleon. As he could not trust to force of arms, he resorted to intrigue. The treaty of 1815 had been annihilated — France hoped to benefit by it.

On August 5th, Benedetti wrote the following letter to Prince Bismarck:

" *My dear President:*

" In answer to communications made by me on July 26th, '66, from Nikolsburg I have received a plan from Vichy for a secret treaty, of which I enclose a copy, which you may read and examine at your leisure. I am ready to talk over the matter, whenever you think the proper time has arrived.

" BENEDETTI."

The treaty of Nikolsburg guarantied Saxony's territorial possessions and Austria's consent to the Prussian annexation of those territories, which had fought against Prussia.

The increase of territory was to France the most obnoxious condition, and Drouyn de l'Huys insisted upon a corresponding cession of German territory to France.

Benedetti delivered France's ultimatum Aug. 6, 1866: "Mayence or war," to which Bismarck gave the answer, "Well, war then."

Benedetti left Berlin.

Von Moltke was ready to march.

Matters remained in a state of uncertainty for two weeks, when Napoleon disclaimed any serious intentions against Prussia. " I have neither men, nor horses, nor cannons," exclaimed he, when the minister of war delivered his last report.

If Bismarck showed consummate skill before the conclusion of the peace treaty, he evinced great boldness at a time when many statesmen would have been discouraged.

The leniency towards Austria was the surest way of securing her friendship for the future, and it had already been agreed upon to remunerate the dispossessed princes munificently.

The year of 1867 opened not auspiciously for Bismarck and his work. France, whose hopes for territorial acquisition had been dashed; the antipathy of the South German states in the work of unification; the particularistic tendencies of the states, which were to form the North German confederation, were problems the solution of which taxed his utmost energies.

The political animosities in South Germany were fanned by influences from the Vatican, which now, for the first time, saw conclusively, that a united Germany under Prussia's hegemony would be the death-knell to Romanism in Germany.

With a final desperation, means were set in motion in Rome, Austria, France and at home to neutralize, if possible, the effect of the measures proposed by Bismarck for political union and separation of church and state. But the old, ideal longing after a strong fatherland helped the new confederation to overcome all dangers and steer onward to national unity.

In the winter of 1869, von Moltke prepared his famous campaign plan in case of war with France, which in 1870, was carried out to the letter.

There are sufficient evidences, however, to show that Napoleon himself was adverse to war.

The Mexican campaign had shown the utter unreliability of his army, and the death of Maximilian was the crowning act of an inglorious war. The intrigues of ex-King George of Hanover at Paris; the formation of a Polish legion in France; the open letter of the elector of Hessia; the agitation in Denmark and the encouragement it received from Paris, showed that the emperor personally had lost control of the situation. Victor Emmanuel, in a fit of pious remorse, was ready to form an alliance with France, contrary to the wishes of his ministry. The intrigues about the Belgium-French Eastern Rail Road; the obstacles in regard to the St. Gotthard Rail Road were indications of the coming storm. Romanism, however, was the visible dawn behind all these machinations. Empress Eugenie and her followers were merely the marionettes in this dark play.

Bismarck hastened the consolidation of the North German confederation, and tried to overcome the opposition of the different states. In all his speeches, up to the time when the war drum silenced all admonitions, he urged harmony and united action against the common foe.

Documents found in France prove conclusively, that the church party was chiefly instrumental in hastening the issue. Jesuitism forced Melac and Turenne across the Rhine; devastated the Palatinate; wrenched Strassburg from Germany. The followers of Loyola had settled in France, Belgium and Holland, to keep up the fight against Protestant Prussia. Father Bekh gained the ascendancy over Pope Pius IX., and the latter saw in the former's doctrines alone the expression of true faith. Italy's unification and Austria's loss of Lombardy had robbed the Jesuit curia of the material nerve of their power.

Austria's defeat in 1866 annihilated their cherished hope of regaining their worldly (temporal) possessions by means of the sword, and filled them with terror lest the German race should triumph over their Latin neighbor.

To frustrate this, two motors were set in motion: the so-called invincible military power of France: and the dogma of papal infallibility. Napoleon took the part assigned to him. The first card played was Napoleon's request, through Benedetti, that Prussia might assist France in the annexation of Luxemburg. Bismarck refused.

The church and military party in Paris proposed further demands, when opportunity should offer itself. It needed little to set the ball in motion. The candidature of Prince Hohenzollern Sigmaringen for the Spanish crown offered the desired pretext. In inducing his kin to withdraw his acceptance King William had taken from Napoleon all pretence for war; but the French ruler, lulled into security by General Leboef's readiness, ordered a throne for a triumphal entry into Paris, including all requisite decorations, laid out the programme for the march to Notre Dame to listen to the Te Deum, and — declared war against Prussia.

" The reasons assigned for this war were so flippant, the insults at Ems so coarse, that Germany, from the Alps to the Baltic, rushed to arms. King Ludwig of Bavaria, in his despatch to King William, July 15th, gave the parole to Southern Germany: " We shall go with you against the common enemy."

Three days after the adjournment of the North German parliament, which had accepted France's challenge, the dogma of infallibility was proclaimed at Rome. Its voice was drowned amidst the military march of the German hosts towards the Rhine.

After the battles of Weissenburg, Woerth and Saarbrücken, Bismarck published the confidential communication of Beneditti's, of Aug. 5th, 1866.

The results of the Franco-Prussian war are too fresh in our minds to engage our further attention.

After the battle of Sedan, Bismarck, in a circular despatch, dated Sept. 16th, says:

" It will be necessary for Germany, in order to secure peace for the future, to make France less able to attack us; the open borders of South Germany must be protected and those fortresses which have been the starting point of all French invasions, must be brought into our possession."

On December 3, 1870, King Ludwig of Bavaria announced in Versailles " that the time had come, when all Germany was ready to confer the old imperial crown upon him, at whose side they were fighting for Germany's honor, and on the 18th of the same month King William received the imperial delegation of the North German parliament.

The crowning event of Prince Bismarck's life, the proclamation of the German empire at Versailles, on the 18th day of January, 1871, wanted no element of picturesque effect, of historical solemnity, or of political significance.

On February 20th, 1871, Prince Bismarck invited Bavaria, Wurtemberg and Baden, to participate in the final arrangement of the work of peace, which was concluded six days afterwards.

The French war, like the Austrian, introduced a new order of things, to which it was necessary to adjust the civil and political machinery, and it has been followed by a course of domestic legislation, extending to the present time.

Alsace and Lothringen were reunited with Germany, and France had to pay an indemnity of one thousand millions of dollars. When President Thiers had signed the articles of peace, he remarked to Prince Bismarck: "Peace is now secured forever," to which Bismarck replied: "I doubt it. Old as my family is there has not been a generation in which some of them have not fought against France. And this state of things will, I fear, continue."

The most important enterprise of internal reform, in which Bismarck is now engaged, is the campaign against the power of the Roman Catholic church in Germany.

The proclamation of the infallibility dogma, and the reorganization of the German empire so affected the relation between pope and kaiser that in the opinion of Prince Bismarck — which the emperor and the majority of the people shared — a new adjustment, which would secure the state greater freedom of action, and more ample means of self-defense, had become imperatively necessary.

This question between the Catholic church and the state is no new one. Mr. Wheaton, our embassador to Berlin, wrote as early as Dec. 6, 1837, No. 55. "The disputes which have recently taken place between the Prussian government and the archbishop of Cologne have at last been terminated by the forcible removal of the prelate from his post to the fortress of Minden in Westphalia."

The principal points in dispute were: 1. Education. 2. Mixed marriages. 3. The publication of the papal bulls.

In a despatch [92], dated the 2d of February, 1839, in speaking of "the conduct of the Prussian government in its intercourse with the papal see and its proceedings towards the Catholic prelates," Mr. Wheaton said:

"This question still continues to be a constant source of uneasiness and debility to Prussia.

"The Austrian government is more successful in managing the clergy in its dominions. Measures which on the part of a Protestant sovereign are regarded as proofs of the spirit of proselytism and persecution, may be, and in fact are, accepted with docility when proceeding from the house of Austria. This fact tends to confirm the suspicion indulged by many persons here, that the religious dissensions in Prussia have been, if not fomented, at least regarded with no unfavorable eye by Prince Metternich, who seeks to weaken the increasing influence in Germany obtained by Prussia through the commercial union, by opposing moral to material interests, and engaging Prussia, which, ever since the thirty years' war, has continued to be the representative of the Protestant party in Germany, in an embarrassing conflict with a religious faction, from which Austria has not only nothing to fear, but upon whom she might count as her natural ally in a struggle for political influence and power."

In 1850, a new fundamental or constitutional law was enacted, that the ecclesiastical organizations named in the law, among which was the Roman Catholic church, should have the right of managing their own affairs. This law continued in force until 1873, and under it the Roman Catholic church in the Rhine provinces prospered greatly.

On the 5th day of April, 1873, the fundamental law of 1850 was amended, so as to give to the state a supervisory control over the ecclesiastical organizations. The right of the Evangelical, Roman Catholic and other religious organizations to manage their own affairs was to remain, but subject to the laws of the state and to a legally organized state inspection. The law passed upon May 11, 1873, related to the education of priests and religious teachers. It required all priests to be educated in Germany, and it gave to the state authorities a power of examination and rejection of unfit persons. It also established at Berlin an ecclesiastical court for the purpose of hearing and finally determining cases arising under these ecclesiastical laws, or from violations thereof. This court was to consist of eleven members, six of whom were required to be regular judges, and they were authorized to order, in cases of adjudged violations of these laws, the several measures of punishment provided by the laws.

In the session of 1874, there was still further legislation. By the law of May 4th (1874), provision was made in case of a vacant bishopric for authorizing a person to perform the functions of the office and to administer the temporalities. The new bishop, when appointed, was required to give the upper president of the province notice of his appointment, and to prove to the satisfaction of the proper officer that he possessed the personal qualifications for the office required by law, and further, to take an oath of allegiance to the sovereign. In case of his rejection by the civil authorities, he had the right of appeal to the ecclesiastical court at Berlin, whose decision was to be final. If, however, he should undertake to exercise his office without authority, he was to be punished in the manner prescribed by law.

Upon a vacancy by judicial determination, the upper president was to summon the cathedral chapter, in order that the vacancy might be filled by election; and in case no election should be had, then the minister for church affairs was authorized to appoint a commissioner to manage the real and personal property.

Provisions were also made for filling vacancies in other orders of the priesthood. The persons appointed under the provisions of the law were authorized to cause this to be done by election by the congregation, and provisions were made for holding such elections, and for investing the persons elected with the offices.

On May 20th, 1874, another law was passed concerning the management of the vacated Catholic bishoprics.

On the 5th day of February, 1875, the pope issued his encyclical letter, addressed to "his venerable brothers the archbishops and bishops in Prussia," in which among other things he said:

"In order to fulfil the duties of this apostolic seat we declare publicly to all whom it concerns, as well as to the entire Catholic world, that these laws are null, because they are contrary to the divine constitution of the church; for it is not to the powers of the earth that the Lord has committed the bishops of His church in what concerns His sacred service, but to Peter, to whom He has committed His lambs and His sheep."

The gauntlet thus thrown down was taken up at once at Berlin. "We shall not go to Canossa."

A law was passed for the management of the property of the Catholic church; and on the 3d of March, 1875, a law concerning the suppression of the payment of the state aid to the Roman Catholic bishops and clergy. It absolutely suspends such payments, but the suspension is to be removed so soon as the archbishop, or bishop, etc., pledges himself in writing to obey the laws of the state. The revocation of such a pledge, once given, is to involve dismissal from office by judicial sentence, and incapacity for the exercise of office thereafter.

The Roman church in Germany is divided. One branch sends a deputation to the pope with an address, in which they

"Declare before you, most holy father, that no human force shall separate us from our lawful pope, for we remember, that it is an eternal truth that one of the conditions of salvation is to be subject to the pontiff at Rome."

On the other hand a large number of Roman Catholic members of the Reichstag and Landtag have joined in a protest, in which it is said that

"We dispute in the most decided manner that the ecclesiastical laws of the German empire and of the Prussian state entirely overthrow the divine government of the church, and reduce to nothing the inviolable jurisdiction of the bishops; and we protest solemnly; first, against all principles set forth in the papal document, which are dangerous to the authority, the constitution and the existence of the state; and most especially, secondly, against the claim of the pope to declare invalid state laws, which have been enacted by constitutional means. We are moreover of the opinion that the teaching of the Catholic church expressly commands every Catholic to recognize as fully valid and binding all state laws enacted in constitutional manner, and to give his obedience to them."

On June 20, 1875, a law was passed concerning the management of property in Catholic parishes.

On Sept. 29, 1876, a decree was issued concerning the exercise of the right of supervision on the part of the state in the administration of property in the Catholic dioceses. The fight is still going on. All that can be said by an impartial observer, who does not believe in the infallibility of the pope in matters of tactics, is, that with the prudent and tenacious energy of the government of Prussia, and with the predominance of the national sentiment over the religious instinct, which is the distinguishing characteristic of Prussian education among cultivated minds, the victory will be on the side of the state.

Prince Bismarck entertains the most friendly sentiments towards the United States, "that great commonwealth, which has taught the European people the art of self-government, which side by side with most enlightened nations marches in the path of civilization, and which has gained, for the cause of true humanity, through the greatest struggle of modern times, the most splendid triumph for mankind."

The outbreak of our rebellion gave him food for reflection. He followed our war step by step, sympathizing with the cause of humanity and predicting its final victory.

His own sentiments and those of the German government were expressed in the Reichstag the day after the assassination of President Lincoln, when Dr. Loewe, a member of the Reichstag, prefaced appropriate resolutions as follows:

"Gentlemen: I have ventured to request the president to permit me to make a communication, for which I claim your sympathy. That which I wish to request of you does not, indeed, belong to the immediate field of our labors, but it goes so far beyond the narrow circle of private life that, in union with a number of our colleagues, I have ventured to call your attention to it. A considerable number of our colleagues feel the need, under the dismay produced by the news of the unhappy death of President Lincoln, to give expression to their views in regard to his fate, and their sympathy with the nation from which he has been snatched away. Abraham Lincoln has fallen by the hand of an assassin, in the moment of triumph of the cause which he had conducted; and while he was in hopes of giving to his people the peace so long desired. Our colleagues wish, in an address, to express the sympathy not of this House, that I may say in order to remove all apprehension of a violation of the rules, but the sympathy of the individual members of the House, in this great and unhappy event. This address we desire to present to the minister of the United States.

"Gentlemen, I will lay the paper on the table, and I beg those of my colleagues who share with me the feeling of warm and heartfelt sympathy in the lot of a nation which is united by so many bonds with our own people, to give expression to those feelings by appending their signatures to the address. These sympathies I regard as all the more justified since the United States have won a new and splendid triumph for mankind, through the great struggle which they have been carrying on for the cause of true humanity, and which, as I confidently hope, in spite of this murder of their chief, they will conduct to a successful termination. In expressing our feelings of pain, we desire, at the same time, to prove our hearty sympathy with the American nation, and those of our brothers, who have taken part in the struggle for their cause. The man, gentlemen, who has fallen by the murderer's hand, and whom I seem to see with his simple, honest countenance; the man who accomplished such great deeds from the simple desire conscientiously to perform his duty; the man who never wished to be more or less than the sincere and faithful servant of his people; this man will find his own glorious place in the pages of history. In the deepest reverence, I bow my head before this modest greatness, and I think it is especially agreeable to the spirit of my own nation, with its deep inner life and admiration of self-sacrificing devotion and effort after the ideal, to pay the tribute of veneration to such greatness, exalted as it is by its simplicity and modesty. I beg of you, gentlemen, accordingly, to join in this expression of veneration for the great dead, which, without distinction of party, we offer to him as a true servant of his state, and of the cause of humanity."

The whole House rose in token of concurrence.

DRINKING-WATER AND SOME OF ITS IMPURITIES.

[A paper prepared by F. G. Ballart, and F. M. Comstock — Fellows of Union College, and read by Prof. M. Perkins, before the Albany Institute Oct. 2, 1877.]

Much attention has been given of late to the drinking-water supplied to cities. In England the subject has been regarded as of so much importance that parliament has appointed committees at various times to investigate the subject. Their reports have done much to turn the public attention in that direction. The question is now often asked, "What constitutes good water?" This may be answered roughly by saying that good water must be transparent, colorless, odorless even when a bottle half filled with it, is placed in a warm place for several hours and then shaken, and without taste except perhaps a slight pungency due to oxygen or carbonic acid. But water may comply with all these conditions and still be unsafe to drink. It may contain injurious substances in suspension or solution, in sufficient quantities to render the water bad, and still show no traces on a rough examination. These impurities can only be determined by a careful analysis of the water. Let us consider a few of these impurities.

Natural water often contains carbonate of lime, sulphate of lime, sodium, magnesium, iron, etc., in solution. They also contain phosphates, chlorides, and nitrates. All natural waters, even rain water, contain the latter in certain proportions. Almost all of them contain the salts of ammonia. Pond, lake, and river waters are generally softer than spring water for the reason that while those bodies of water receive the waters of springs, they also receive a considerable quantity which has simply run over the surface of the earth without taking with it much soluble mineral matter. Rivers are more likely to be charged with suspended impurities for the reason that their waters, which have not been filtered through the soil, carry with them a certain quantity of mud and organic matter. When water flows into lakes and the sediment subsides, it becomes clear, but in streams where the water runs rapidly, it has no opportunity to deposit its sediment and it often appears very turbid.

The question arises, which of these impurities may be allowed, and in what quantities. We will first consider the lime and magnesian salts. In order to determine them roughly the method devised by Dr. Clark and called "Clark's Method" is generally employed. This method is based upon the fact that when pure water is mixed with a very small quantity of alcoholic solution of soap, and shaken for a few minutes, a froth is produced which is persistent for some minutes; while on the contrary, when the water contains lime or magnesian salts in solution, no such froth is produced, until a sufficient quantity of the soap solution has been added to decompose them. The amount of soap solution requisite to produce the froth in water containing such salts is moreover to such an extent proportional to the amount of these salts in the water, that with a soap solution of known volumetric value, the degree of hardness is indicated by the quantity requisite to produce the froth in a given quantity of water. The hardness is expressed in degrees each of which represents .01 grm. per litre, or one part per 100,000 of carbonate of lime or its equivalent of some other lime or magnesian salt. Water of less than 8°.5 hardness is called soft water, of more than 8°.5 hard water. Water which is too hard is less wholesome than that which may be called soft. It is not so good for household purposes nor for boilers. It also entails an enormous waste of soap.

Natural waters contain carbonic acid dissolved in them, and also the constituents of the air. Water containing carbonic acid in solution has the property of holding in solution quantities of certain salts that would not otherwise be dissolved. If this carbonic acid be driven off by boiling, a precipitate of carbonate of lime is formed, and the water loses part of its hardness. That which remains is called *permanent* hardness, while that which disappears is called *temporary* hardness, and is due to the carbonates. The permanent hardness is due chiefly to sulphate of lime, chloride of lime and to magnesian salts. These are all highly objectionable.

As heat liberates carbonic acid we would naturally infer river or lake water to be softer in summer than in winter, and this we find to be true. The hardness of the water also varies with the height of the stream. After a rain, when soft rain water in large quantities has run in, the stream is softer, and when it is low the water is harder. This would account for the greater hardness of the water in the winter, for there is no soft rain water flowing in, the river being almost entirely supplied from springs. The following table shows the hardness of the Mohawk at Schenectady for each day during the month of March, 1877 with the height of the river above low water for the first two weeks.

Date.	Hardness.	Height of river.	Date.	Hardness.	Height of river.
Mar. 1	12°.5	1 ft.	Mar. 15	11°.6	6 ft. 3 in.
" 2	12.3	1 "	" 16	14.6	
" 3	12.	1 "	" 17	13.	
" 4	13.5	1 "	" 18	13.	
" 5	13.5	2 " 6 in.	" 19	13.	
" 6	13.5	3 " 0 "	" 20	12.	
" 7	13.	2 " 10 "	" 21	12.	
" 8	12.5	2 " 10 "	" 22	11.5	
" 10	11	17 " 2 "	" 23	11.	
" 11	10	11 " 2 "	" 26	10.	
" 12	10	10 " 0 "	" 27	10.	
" 13	11	8 " 7 "	" 28	10.	
" 14	11.4	7 " 7 "			

Taking the average of the first seven days we find it to be 12°.9 and of the last seven 10°.9, a difference of two degrees, due, without doubt, to the inflowing rain and snow water.

A great source of pollution to water is sewage. Dr. Frankland says, "nearly the whole of the animal matter which gains access to drinking-water consists of sewage, that is, solid and liquid excrements." This is dangerous because it contains decomposing organic matter. The products of the decomposition of the animal matters are far more injurious than those from the vegetable, and are highly injurious even when present in minute quantities. These impurities do not make themselves apparent to the taste, but on the contrary, wells containing such waters frequently acquire a wide spread reputation and people go a long distance for the waters which they regard as of a peculiarly fine flavor. Nevertheless they contain an active poison. Many diseases of the most fatal character are now traced to the use of water poisoned with the soakage from soils charged with sewage and excremental matter. Sudden outbreaks of disease of a dysenteric character are often caused by an irruption of sewage into wells, either from a break in the sewer or from a cesspool, or from some peculiarity of the season. Such contamination is not indicated by any perceptible change in the appearance of the water.

In Dr. Schuyler's *Turkistan* we find the following account of a disease which is quite common among the inhabitants where the water is bad. "The Sarts are not only attacked by the usual maladies to which our frame is heir, but they have besides two or three which are peculiar to the country, or at all events very common there. One of these is the *reshta* or Guinea-worm (*Filaria medi nensis*) which is known also in several other parts of the world where the climate is hot and the water bad. It is probably produced by infusoria from bad water being taken into the system, which in about a year developes into a white worm that passes through the body and makes its appearance usually in one of the legs. The part affected begins to swell, and the native physicians to whom the symptoms are well known immediately make an incision, and dextrously catching hold of the worm, slowly wind it off on a stick. This is an operation which has to be done with great care, as should the worm be broken each part would become a separate worm, and would be the cause of innumerable ulcers. There are often many such worms at the same time. The disease is accompanied by severe pains in the bones and internal heat and thirst. * * * * Most of the water for drinking is taken from the large pools and tanks where it has remained in a stagnant state for many months." * *

When sewage flows into running streams, besides being largely diluted, a portion of it is oxidized and another portion is taken up by fish, infusoria, aquatic plants, etc. The completeness of this oxidation is still a disputed point with chemists, some holding that the water is completely purified by merely flowing ten or twelve miles, especially if it be broken up by dams or rifts, and others contending that it can never be completely purified in this manner. The Thames, which receives a large amount of sewage above London, is, according to the report of the committee of chemists appointed by the royal commission, "perfectly wholesome, palatable and safe" at that city. It is claimed on the other side, that water need not necessarily contain enough animal matter to be readily recognized by chemical tests in order to be prejudicial to health. "At the present time, a chemical analysis *alone* is not sufficient to determine the desirability of a given water supply. The rice-water evacuations of a cholera patient, diluted with no very large amount of water, would form a liquid in which chemical tests would fail to indicate the presence of anything which could be pronounced injurious, and yet there is no destruction of the poisonous material; it is still in the liquid, although not to be recognized, and such water is now regarded by physicians as the most direct and certain vehicle for the transmission of Asiatic cholera." (Fifth Annual Report of the State Board of Health of Mass., Jan., 1874.) It is now very generally held that drinking-water polluted by even a very small amount of excremental matter from those suffering from typhoid fever, is capable of propagating that disease. This was shown most remarkably by the case of the village of Lausen, Switzerland, when all the inhabitants except those living in six houses procured their water from one spring. Typhoid fever made its appearance in nearly every house except the six that did not use the water from the spring: seventeen per cent of the whole population had the disease. The cause was found a mile away at an isolated farm-house on the opposite side of a ridge of land, where an imported case of typhoid fever, followed by two others, had occurred shortly before the outbreak. From the valley where this farm-house was situated, there extended to the valley of Lausen, a stratum of porous earth, based on some impervious floor dipping towards Lausen, and a small brook that ran near the house into which the dejections of the typhoid patients were thrown, and in which their linen was washed being used to irrigate some meadows, sank into the porous stratum, passed through it, under the ridge, and poisoned the Lausen spring. To prove this, careful experiments were made. Eighteen cwt. of salt were dissolved at the meadows, which was followed by its appearance in the spring. Fifty cwt. of flour then being mixed with the water, no traces of it could be discovered at the spring — the water evidently filtering through the earth, and not passing by an underground channel. This filtering removed the *suspended* flour but could not remove the *dissolved* salt. In this case at Lausen, we have the oxidizing influence of one mile of porous stratum, which, though much more effective than the same distance in the open air, would be utterly unable to destroy the fever germs.

Nitrates and nitrites are produced by the oxidation of nitrogenous organic matter and almost always from animal matter. They are called in the Registrar General's Report the test of "previous sewage contamination." They are found in all waters, even in small quantities in rain water, and though not injurious in themselves yet lead us to suspect that the water containing them in solution, to any extent, has at some time been contaminated largely with organic matters. These organic matters have been oxidized and the results are nitrates and nitrites, but it may some time happen that they are not all oxydized, and then we have them existing in a dangerous form, as at Lausen. The chlorine is of considerable importance in judging of the character of a water, as it is usually derived from animal excreta, though in some cases it may come from the soil. It is usually present as sodic chloride, but occasionally as a calcic salt. Of course, attention should be paid to the geological nature of the district from which the water comes, its distance from the sea, etc., in order to decide on the origin of the chlorine.

Unpolluted river and spring waters contain a little less than one part in 100,000 of chlorine: average sewage in water-closeted towns, about ten parts. Its amount is scarcely affected by any amount of filtration through soil. Thus the water flowing from land irrigated by sewage, contains as much chlorine in proportion as the sewage itself, unless it has been diluted by subsoil water or concentrated by evaporation. Under ordinary circumstances, a water containing more than two or three parts of chlorine in 100,000, should be regarded with suspicion.

When the free ammonia exceeds 8 parts in 100,000 it almost invariably proceeds from the fermentation of urea into ammonia carbonate, and is a sign that the water in question consists of diluted urine. In these cases the water will also be found to contain large quantities of chlorine.

Ammonium salts are found in natural waters in exceedingly small quantities. They do no particular harm in themselves, but they frequently come directly from sewage.

The annexed table shows the results of the analysis of the water supplied to Schenectady, Troy and Albany. The nitrites were reduced to nitrates and both appear under that heading. Ammonium salts are represented by organic nitrogen. The analyses were carried on under the supervision of Prof. Perkins. The numbers represent parts per 100,000 by weight.

TABLE

Showing the Results of the Analysis of the Water supplied to the Cities of Schenectady, Troy and Albany.

No.	Sample.	Date.	Source.	Color.	Hardness. Temp.	Hardness. Perm.	Hardness. Total.	Free Ammonia.	Organic Nitrogen.	Nitrates.	Chlorine.
1.	Schenect. Water-works. .	April 25	Mohawk. .	Clear.	4°.4	7°.5	11°.9	None.	.00300	.025619	.80
2.	Troy Water-works.......	April 3	....	"	4°.3	5°.5	9°.8	"	.00400	.040740	.50
3.	Albany, Water-works...	April 3	Hudson. ..	"	......	......	10°.0	"	.00500	.051928	.60
4.	Albany, " "	May 17	Tivoli lake.	"	......	......	.....	"	.00500	.025536	.30
5.	Lafayette St., Schenect.	Mar. 27	....	"	......	......	34°.0	"	.00500	Not taken	11.00
6.	do " "	May 31	....	"	......	......	.....	"	....	....	12.00
7.	do " "	Mar. 30	....	"	......	... .	52°.0	.012143	.01500	3.337003	28.40
8.	Church St., Schenect....	April 2	....	"	.....	......	.....	None	.00600	4.044600	12.80
9.	Jay St., Schenect........	April 17	....	"	......	......	.....	.004857	None	.840700	2.20
10.	Albany.	April 19	....	"	......	......	12°.7	None	"	3.656310	2.80
11.	ParkPlace, Schenect.....	May 31	....	"	......	......	.....	"	.00700	.831503	1.50

The numbers in a drinking-water representing ammonium salts ought to be in the third place of decimals for parts in 100,000, or if in the second place, ought to be small.

Let us now look at these results and see what they indicate. The total hardness of the water supplied to the three cities is about the same, the difference being no more than would exist in the same water on different days. In permanent hardness the Troy water is much better than that of Schenectady. The nitrates indicate the sewage contamination perfectly, increasing as we go down stream from Schenectady to Albany. Above Schenectady, there is very little sewage flowing into the Mohawk, until we reach Utica, eighty miles above, that being the only place on the river with a system of sewers. The river itself passes over many rifts and shallows between these places, affording every opportunity for the oxidation of the organic matter. At Troy the river has received the sewage of Cohoes, Waterford, Lansingburgh, etc., and at Albany that of Troy and West Troy in addition, and the nitrates accordingly increase. The water of Tivoli lake having received no sewage is consequently purer than that from the river, and is the best water supplied to these cities. As far as the analyses go, however, the river waters are perfectly safe and wholesome, being far purer than any well-water analyzed.

In the analyses of the well-water from Schenectady we find nothing more than would naturally be expected. The city is a very old one, situated in a valley, and without the slightest attempt at a system of sewers. For over two hundred and fifty years the inhabitants have been pouring their refuse on the ground, and the contents of their privy vaults have been soaking into the earth.

In old cities the ground becomes almost honey-combed with vaults. As fast as one is filled, it is covered up and another is dug. When the property is sold, the first vault is forgotten or unknown. Finally a well is to be dug on the place, and it is easily seen that there is some possibility of striking an old vault.

A short time since, on removing a building in Schenectady, no fewer than five vaults were found on a lot of ground only 25 feet by 100. Into such soil as this the wells are dug, and the water in some of them has become nothing but sewage in a concentrated form. There are always cases of typhoid fever in the city, and an unhealthy season increases their number at an alarming rate.

Samples 5 and 6 were from the same well, the former taken just before it was cleaned, and the latter about six weeks after. There is a vault a short distance from the well with which it is evidently in direct communication, the chlorine being more in the second analysis than in the first. No. 7 was furnished by a physician who was called to prescribe for a man sick with typhoid fever. He suspected that the cause lay in the water, although the man affirmed that it was the best water in the city. The analysis shows, besides ammonia, organic nitrogen, and nitrates in large quantities, an amount of chlorine nearly three times as great as that in common sewage.

In No. 8 the nitrates and chlorine were very high, especially the former. The well is only eighteen feet from a vault.

No. 10 was received from a physician at Albany. He writes as follows concerning it. "I send you a specimen of well-water which I think has caused three cases of severe illness, two of which were fatal. I was called some months after these cases, to see a patient who had a high fever (Temp. 105°. pulse 140) with diarrhoea and nausea, in whom I could find no disease of any organ to account for the fever. I forbid her use of the well-water and she commenced to improve and is now, after the lapse of two weeks, nearly well. Since I saw her, she has been drinking filtered rain-water. The well in this case is within ten feet of a privy-vault and the two have been thus located for twenty years."

These examples show us how nearly impossible it is to obtain pure water from city wells. Before digging a well, even in the country, the nature of the soil should be considered, and care taken to have it sufficiently distant from any vault or barnyard to avoid all possible contamination of the water.

UNION COLLEGE,
Schenectady, June 25, 1877.

The subject of the foregoing paper was discussed by Prof. Prescott, and Dr. Stevens, the latter remarking as follows:

The important fact in the subject of this paper is one which has not until recently received the attention which its just importance demands, namely, that dangerous contamination of drinking water depends, not upon the quantity of organic matters which it may contain, but upon the presence of the specific poison which generates typhoid fever and kindred diseases.

This poison emanates from the excretions of the sick from these diseases, and such excreta when mingled with drinking-water, even in most minute quantities, are exceedingly dangerous.

One may drink water with safety for a long time which contains very large quantities of organic matter. The fact related by Mr. Prescott of drinking the water expressed from the moss of a swamp for many days together, without harm, illustrates this fact; but had even the smallest quantity of the excretions from a typhoid patient found its way into this water, our friend would not, in all probability, have been with us to-night to relate his adventures in the mountains.

A striking illustration of the dangerous qualities of water which may run perfectly pure and comparatively free from organic matter is found in the case of the Swiss village mentioned in the paper just read. Here water contaminated with the typhoid poison, after more than a mile of thorough percolation under ground, was still virulent enough to carry sickness and death to a whole community.

Thus it will be seen that a spurious importance has been assigned to the presence of organic compounds in water, and that the great and all important question is, how to secure absolute safety against any contamination from the excreta of persons suffering from malignant zymotic diseases. So long as sewage is poured into the source of drinking-water there is imminent danger to those using it, unless the conditions are such as to insure the destruction of the poison.

It is a matter of very little comparative consequence whether one drinks water containing algales which may look unpleasantly or even smell disagreeably, but water of apparently greatest purity, in which neither chemical analysis nor microscopic examination reveals the presence of danger. may yet be the medium for transmitting a deadly poison.

ALCOHOL — IS IT A FOOD?

By Willis G. Tucker, M.D.

[Read before the Albany Institute, March 6, 1877.]

The uses, abuses and effects upon the system of alcoholic drinks, are subjects which have been much discussed, and which may be viewed from a variety of standpoints. The moralist considers the influence exerted by their use upon society at large; the jurist seeks to determine what laws should be enacted to regulate their production and govern their sale; the physiologist busies himself with investigating their action upon the human system in a state of health, and the medical man studies the results which follow their administration in disease and their value as remedial agents. Each of these points of view is separate and distinct, and if discussions upon the alcohol question are ever to prove of value, their range must be limited within natural bounds. Questions so important as those which arise when the uses of alcohol are discussed, should be dealt with rationally and logically. The wholesale denunciations, arbitrary dogmatical assertions, and distorted statistical statements so often put forth as arguments by those who feel themselves called upon to agitate these questions, are entirely out of place in the discussion of such important themes.

Dismissing, then, all reference to those relations which alcohol bears to social science, the law and to medicine, let me ask your attention for a few moments this evening to a single point connected with its physiological action — our query being, are the effects of alcohol upon the system such as will entitle it to a place among foods?

Of alcohol, by way of definition, little need be said, save that it is a chemical product resulting from vinous fermentation, an obscure process in which sugar is transformed through the agency of some nitrogenized albumenoid substance or ferment into alcohol and carbonic acid, and that it is the most important constitutent in all liquids classed as intoxicating. It matters not whether they be the lightest fermented liquors or the strongest distilled spirits, they all owe their excitant properties to the alcohol which they contain in quantities varying from two to fifty-five parts in one-hundred by volume. These liquids, if imbibed in quantities proportional to the amount of alcohol contained in them, would produce precisely similar effects were not to the properties of the alcohol added those of the other substances with which it is combined. Thus champagne is doubly stimulating from the free carbonic acid gas which it contains; port possesses astringency which it owes to its tannic acid; gin the power of affecting the kidneys, due to its juniper; whiskey is regarded as slightly aperient, while brandy is believed to produce a contrary effect. Fermented liquors containing hops are held to possess tonic properties, while the sugars, starchy matters and albumenoid substances which they contain are undoubtedly, so far as they go, true nutrients. Such differences as these are however secondary and of comparatively little importance. The primary constitutional effects produced by different liquors depend upon the alcohol, are essentially the same in all cases, and proportional to the amount contained in any given volume. The idea that pure alcohol, when properly diluted, is poisonous, or that its properties are *materially* altered by the other substances with which in wines and spirits it is blended, and which give to these liquors their delicate odors and fine flavors, is entirely wrong. If some liquors are especially deleterious, it is not because the *alcohol* in them is ranker, but it is due to the fact that the fusel oil or other impurities have not been properly separated from them, or that they have been purposely adulterated. Wines and distilled liquors are mellowed and improved by age, but the process depends upon the development of various ethers and volatile principles, and not upon change which the alcohol undergoes. Indeed, of late years, pure alcohol has been medicinally employed to a considerable extent and with as good results as those which follow the administration of whiskey or brandy.

Under the general term ALCOHOL, then, we include all those liquids which, containing it in varying quantities, are used as stimulants, and are capable of producing intoxication. In attempting to define the term food, we meet with greater difficulty. The dictionary definitions are most of them quite unsatisfactory, comprehending many substances which cannot properly be considered foods, and excluding others which are essential. The physiologists are scarcely more exact and in their definitions show a very great diversity. A well known authority includes under the term food, "all those substances, solid and liquid, which are necessary to sustain the process of nutrition." He evidently means those substances which are capable of sustaining or contribute to the sustenance of the process of nutrition. The definition of another physiologist includes not only all those substances capable themselves of nourishing the body, but also all others which may indirectly accomplish the same end "by influencing favorably the process of nutrition or by retarding destructive assimilation." This seems too broad. Dr. Edward Smith in his excellent little treatise on *Foods* is fortunate in his choice of words when he says that "a food is a substance which when introduced into the body supplies material which renews some structure or maintains some vital process."[1] The word *maintains* is important; a medicine may modify a vital process; a food maintains it. Accepting then this definition as satisfactory, although it is broader than at first

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[1] Smith, *Foods*, New York, 1874, p. 1.

sight would appear and includes many substances not ordinarily ranked as foods, we see that it but expresses the well known fact that food is required by the body for two great purposes,— to renew its structure and to maintain the vital processes, chief among which is the production of heat. Few single substances, it is true, produce solely the one or the other effect, but yet any given article acts chiefly either as a tissue former or a heat producer. The first class, or tissueformers, are nitrogenized substances from which, combined with mineral matter, the whole frame work of the body is made up. Fat alone, a substance which may almost be regarded as extraneous or non-essential, save that it furnishes a supply from which the heat of our bodies may be kept up for a time if food is cut off, contains no nitrogen. The essential constituents of the body, the fibrine, ossein, cartilagin, albumen, and similar principles are all nitrogenized substances. The second class, the heat producers or respiratory foods, are non-nitrogenized bodies containing carbon, hydrogen and oxygen. Now if alcohol acts as a true food it is evident that it must do so either by a conversion into some nitrogenized proximate principle, or by undergoing oxidation within the body and evolving heat or other form of force.

Having glanced at these elementary physiological facts let us now inquire what evidence there is to prove that it is capable of accomplishing either result.

The claim that alcohol can be converted into tissue substance proper is now less frequently made than heretofore. The attempt has often been made to prove it, but all efforts in this direction have failed, and there are no reliable facts which can be adduced to show that such a change ever does take place. Still that the assertion is made without even an attempt at proof may be seen from the following quotation from a well-known standard treatise on therapeutics by an eminent medical authority. The author says: "Alcohol is itself, in all probability, assimilated.

What else becomes of it? It is probably converted into some one or more of the proximate constituents of the body; and I am among those who believe that it may, through the agency of the vital forces, and in the presence of organized nitrogenous matter, be converted into any one or all of these constituents, excepting only the mineral." Now it is easy to build up theories to support mere opinions, but such labor is worse than useless because it does no good and leads into error. Pray note the query, "What else becomes of it" for it illustrates a style of reasoning which, it must be acknowledged, too frequently obtains in medical works. Why should we ascribe to the vital forces,— forces, of which if any exist distinct from atomic and molecular forces recognized as chemical and physical, we know nothing,— all those changes which, going on within our bodies, seem beyond our comprehension. Such as these are the most futile of hypotheses because they are based upon nothing but ignorance.

It would be a waste of time to enter upon a discussion of this question. It would subserve no good purpose to point out those writers who have held an opinion based only upon an absence of proof. Not only have all attempts to show that alcohol may be assimilated, or rather, converted into assimilable substances, failed, but we may go further and assert that there are many facts which go to prove that it positively interferes with the processes of nutrition. Dr. Beaumont's experiments upon St. Martin,— that singular man who, as the result of accident, lived for many years with a perforation in his side opening into his stomach, through which its interior might be observed and the processes of digestion studied,— proved that "the free use of ardent spirits, wine, beer or any intoxicating liquor, when continued for some days, invariably produced morbid changes,"[1] — changes which he described at length.

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[1] Beaumont, *The Physiology of Digestion*, Burlington, 1847, p. 254.

Among his inferences, deduced from the results of hundreds of experiments which he conducted upon St. Martin, the thirteenth is that "the use of ardent spirits always produces disease of the stomach if persevered in."[1] Now the term 'disease' is somewhat vague, but whether we accept Beaumont's statement or not, we need not stop to argue that digestion and assimilation can never proceed to advantage if the functions of the stomach be interfered with, even if it be not actually diseased. But supposing that alcohol is so taken as not even to interfere with the process of stomach digestion there is every reason for believing that it not only fails to act as an alimentary principle, but that it seriously interferes with the assimilation of those true nutrients which should constitute our food. Flint, in his *Physiology of Man*, says: "alcohol diminishes the activity of nutrition. If it be long continued the assimilative powers of the system become so weakened that the proper quantity of food cannot be appropriated, and alcohol is craved to supply a self-engendered want."[2] Again he says: "the effects of its continued use, conjoined with insufficient nourishment, show that it cannot take the place of assimilable matter. These effects are too well known to the physician, particularly in hospital practice, to need further comment."[3]

It must be admitted, however, that such statements rest more upon the general results gained from experience than upon absolute experimental proof, and that it is difficult to judge accurately of the rapidity and nature of the reparative processes which are going on within the body, so that while we may entertain no doubt as to the influence of alcohol upon them, we may not find it easy to demonstrate

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[1] *Ibid*, p. 300.

[2] Flint, *Physiology of Man*, New York, 1873, vol. II, p. 108.

[3] *Ibid*, p. 109.

it. But in those cases in which there is an extraordinary demand made upon these regenerative powers, as for example in the repair of injuries resulting from accident or disease, we are enabled to form a pretty correct judgment of the effects of alcohol upon them. Now Dr. Carpenter, in his *Prize Essay on the Use and Abuse of Alcoholic Liquors*, has shown that in those who habitually use alcoholic drinks, union of wounds does not take place so readily by 'first intention,' as in those who abstain from them. He cites the experience of Havelock in India who in his *Narrative*, referring to the wounded after the victories in India, says: "The medical officers of this army have distinctly attributed to their previous abstinence from strong drink the rapid recovery of the wounded at Ghuznee,[1] and also quotes from Atkinson, who in his work on Afghanistan states, more explicitly, that "all the sword cuts, which were very numerous, and many of them very deep, united in a most satisfactory manner, which he decidedly attributed to the men having been without rum for the previous six weeks."[1] To these statements, so many others of similar bearing might be added that we seem justified in the belief,— and more especially when the fact that no positive evidence can be adduced to prove that alcohol is capable of assimilation is taken into consideration,— that alcohol is not only incapable of being transformed into any of those substances of which the tissues are made up, but that it actually interferes with the nutritive and reparative processes. As to this view there seems to be now but little if any difference of opinion among recent writers and observers.

But it has often been urged, if alcohol cannot be transformed into nitrogenized substances, may it not be con-

[1] Carpenter, *op. cit.* p. 136.

[2] *Ibid*, p. 137.

verted into fat, of which it contains all the elements, and may not this fat be stored up and afterwards by its combustion furnish heat and force. Such a view of the subject is at first sight plausible, and the results of certain physiological experiments would seem to show that such a change might take place, but let us remember that those liquors which are, by common consent, the most fattening, are those which contain sugar and starchy matter in the greatest abundance. Beer drinkers may become bloated; spirit drinkers seldom. Let us also remember that the sleepy quiet induced by excessive potations may contribute towards the deposition of fat. True it is that in certain cases of confirmed inebriates a deposition of fatty matter does take place around and about the viscera, and that frequently vital organs themselves undergo a fatty change, but I need not remark that it is by no means to be desired that this substance, useful enough no doubt in its place, should be interlarded with the muscular fibres of our hearts, or disseminated through our livers and kidneys. Such depositions and changes of structure are degenerative and abnormal, and take place moreover in those who entirely abstain from alcoholic drinks. Dr. Richardson of London, whose recently printed "Cantor Lectures" *On Alcohol* have attracted much attention, asserts[1] that there is "no obvious chemical fact which supports the hypothesis" that alcohol may be transformed into fat. We believe that within the body sugar may be so transformed and we know also that it may be converted into alcohol, but as yet see no way by which alcohol may be changed back to sugar or directly into fat. We hold that neither by physiological experiments nor logical deduction from observed facts can it be shown that alcohol is a fattening agent.

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[1] Richardson, *op. cit.* p. 61.

Again, it is urged, and with some show of reason, doubtless, that if alcohol is not a direct tissue-forming food, it may at least retard tissue change and diminish the wear and tear of the system. I say with some show of reason, for there is no doubt that, under certain circumstances, when alcohol is imbibed, either less food is required, or the body gains in weight while the excretions diminish. The experiments conducted by Dr. Hammond[1] prove this. But the question then arises, why is less food required, why are the excretions diminished? Surely alcohol cannot create force. Is not the system then debilitated and unfitted for doing its ordinary amount of work, and is not this the reason why it requires less food to support it? An engine run at fifty strokes a minute needs less fuel, but furnishes less power than if the number of strokes be doubled.

Dismissing then the further consideration of alcohol as a tissue-former or a preservative agent, let us now inquire whether it may act as a respiratory or heat-producing food. The impression that until quite recently has very generally obtained is that part at least of the alcohol absorbed after ingestion is carried with the blood to the lungs, where it is rapidly oxidized with the production of carbonic acid and water which are thrown off with the expired air, and that during this chemical change heat is evolved and the temperature of the body raised. Indeed this view is still pretty generally held by those who have failed to keep pace with the advances which physiological science has during late years been making. The idea that alcohol increases bodily heat was for so long a time taken for granted,— statements to that effect were so long allowed to pass unchallenged,— that the belief probably gave rise to the theory that

[1] Hammond, *The Physiological Effects of Alcohol and Tobacco upon the Human System, Physiological Memoirs,* Phila., 1863, p. 48.

alcohol undergoes rapid oxidation or combustion within the system. Thus Bouchardat and Sandras asserted positively in 1847, that alcohol is speedily converted by the inspired oxygen into carbonic acid and water,[1] and the late Professor Johnston in his *Chemistry of Common Life*, says that ardent spirits "directly warm the body and by the changes they undergo in the blood supply a portion of the carbonic acid and watery vapor which, as a necessity of life, are continually being given off by the lungs."[2] Liebig, as is well known, held the same opinion[3] and in his *Chemical Letters* places "spirits" among respiratory foods.[4] Dr Thudichum has declared himself of the same belief, founding it, it would seem illogically, upon the fact that in a number of experiments which he conducted, but a minute portion of the alcohol administered escaped from the body unchanged. He therefore draws the inference that it must of necessity have undergone rapid oxidation and acted as a true food.[5] Stillé in the last edition of his work on *Therapeutics and Materia Medica* presents arguments to prove that the temperature of the body is raised by alcoholic drinks.[6] Dr. Prout held that the temperature was first diminished but afterwards increased by their administration,[7] and we even find Dr. Edward Smith asserting as late as in 1873, in his work on *Foods* to which reference has been made, that spirits of wine cause an increase in the amount of carbonic acid exhaled while brandy, whiskey and gin lessen it.[8] As no explanation is offered for this

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[1] *Annuaire de Therapeutique*, 1847, p. 279.

[2] Johnston, *Chemistry of Common Life*, N. Y., 1873, vol. I, p. 288.

[3] *Animal Chemistry*, Part I, p. 96.

[4] *Familiar Letters on Chemistry*, Lond., 1854, vol. II, p. 106.

[5] Letheby *On Food*, N. Y., 1872, p. 92.

[6] Stillé, *op. cit.*, vol. I, pp. 729–741.

[7] *Edinburgh Med. and Surg. Journal*, July, 1851.

[8] *Op. cit*, p. 377, *et seq.*

remarkable fact, nor indeed can be, we must dismiss it as fallacious. Carpenter in his *Prize Essay* says: "The power of alcoholic liquors to enable the body to resist the depressing influence of external cold is perhaps the best established of all its attributes. * * * * This is by no means surprising. The genial warmth which is experienced for a time when a glass of spirits is taken on a cold day, appears to afford unmistakable evidence of this heat-producing power, and the chemical properties of alcohol would seem to indicate that under such circumstances it does not merely act as a stimulant * * * * but that it also offers the material for that combustive process, by which the heat of the body is sustained, in a form peculiarly suitable for rapid and energetic appropriation to this purpose."[1]

Now the results, almost without exception, of later carefully conducted experiments go to show that alcohol does *not* increase the quantity of carbonic acid in the expired air, but diminishes it, and that it does *not* augment the bodily temperature, but markedly lessens it. Regarding the carbonic acid, the quantity of which would be greatly increased were alcohol directly oxidized in the system with the production of heat, Dr. Prout showed thirty-five years since, that the amount is invariably but not uniformly lessened by the administration of alcohol.[2] Böcker has shown that "in his own case during the use of alcohol the exhalation of carbonic acid from the lungs in twenty-four hours was less than the normal quantity by 165,744 cubic centemetres"[3] equal to about 5.8 cubic feet. Dr. Hammond, in experiments conducted upon his own person observed a constant diminution in the amount of car-

[1] Carpenter, *op. cit*, Phila., 1866, p. 96.
[2] *London Lancet*, 1842–43, II, p. 17.
[3] Stillé, *op. cit.*, vol. I, p. 741.

bonic acid exhaled following the ingestion of four drachms of alcohol three times a day for five days.[1] Dr. N. S. Davis of Chicago states, that the diminution of carbonic acid amounts sometimes to fifty per cent, two hours after a dose of alcohol has been taken,[2] and Perrin,[3] Horn,[4] Vierordt,[5] and many other experimenters give equally positive testimony. And as to the calorific power of alcohol, contrary to what is considered the general experience, and to the statements of the authors quoted, together with many others not mentioned, it is capable of direct proof that its administration causes in man, and in many other of the warm-blooded animals, a decided fall of temperature. Indeed alcohol is now employed as an antipyretic in fevers. There may be at first a slight rise of surface temperature, quickly subsiding and there is undoubtedly experienced a feeling of warmth in the extremities and a certain glow on the surface following the ingestion of alcoholic liquids, but this proceeds in reality from a cooling process which results from the increased supply of blood sent to the capillaries of the surface which, with its temperature lowered, is returned to the heart. This effect is believed to depend upon the action of the alcohol upon the ganglionic nervous system. The control which the nervous filaments exert upon the capillaries is weakened; the normal state of tonicity gives place to a flaccid dilatation; the vessels become distended with blood; a greater quantity is sent to the part, and, therefore, the check upon the heart being relaxed, its pulsations become more frequent. Not only is the blood being more rapidly cooled but an extra amount of work is necessarily put upon the heart.

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[1] *Op. cit.*, p. 48.

[2] *Trans. Am. Med. As'sn.*, vol. VIII, p. 577.

[3] *Archives générales*, 6th series, vol. IV.

[4] Flint, *op. cit.*, vol. I, p. 437.

[5] *Ibid.*

So long ago as in 1848, Duméril and Demarquay asserted that after the administration of large doses of alcohol, there was a fall of temperature.[1] Dr. Davis's experiments gave similar results over twenty years since,[2] and those performed by Dr. Richardson show that with few exceptions, small doses of alcohol lower the bodily temperature, and that without exception the administration of quantities sufficient to produce intoxication causes a very decided fall.[3] Indeed he points out that the sleep of apoplexy may easily be distinguished from that of drunkenness by this fact alone; that in the one case the temperature is above, in the other below the normal standard of 98.5°. He is of the opinion, and who can doubt it, that life is often lost by thrusting intoxicated persons into the cold, damp cells of prisons.[4] A person in such a condition should always be kept warm.

The statements of nearly all recent observers, to a host of whom reference might be made, agree upon this point and Dr. Hayes' experience in the use of alcoholic liquors in polar regions fully corroborates the testimony of scientific observers. He says: " While fresh animal food, and especially fat, is absolutely essential to the inhabitants and travellers in arctic countries, alcohol is, in almost any shape, not only completely useless but positively injurious. * * * * Circumstances may occur under which its administration seems necessary, such for instance, as great prostration from long continued exposure and exertion or from getting wet; but then it should be avoided if possible, for the succeeding reaction is always to be dreaded; and if a place of safety is not near at hand the immediate danger

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[1] H. C. Word *Therapeutics, Materia Medica and Toxicology*, Phila., 1874, p. 103.

[2] *Trans. Am. Med. As'sn.*, vol. VIII, p. 577.

[3] Richardson, *op. cit.*, p. 68, *et seq.*

[4] *Ibid.*

is only temporarily guarded against, and becomes finally greatly augmented by reason of decreased vitality. If given at all it should be in very small quantities frequently repeated and continued until a place of safety is reached. I have known the most unpleasant consequences to result from the injudicious use of whiskey for the purpose of temporary stimulation, and have also known strong, able bodied men to become utterly incapable of resisting cold in consequence of the long continued use of alcoholic drinks."[1] Alcohol then is not a heat-engendering food, but, on the contrary, cold and alcohol are similar agents, and the popular plan of administering the latter to counteract the effects of the former is based upon a fallacy and may be productive of dangerous and even fatal results. As a medicine alcohol may do good *after* exposure to cold by quickening the circulation and producing a temporary stimulant effect, but it should only be administered when the means for supplying artificial warmth externally are at hand.

Still further we hear it alleged by those who admit that alcohol can neither renew structure nor evolve heat, that it furnishes force by its oxidation, which sustains the vital processes. It is said that alcohol is an agent which will burn inside as outside the body, and that the force evolved in its combustion represents a certain amount of work, but that in supplying force to the system by its decomposition, heat becomes latent, a fact which explains the diminished temperature observed after the absorption of alcohol. This view of the case has been ably presented during the present year by a writer in one of our medical journals. The writer takes the ground that alcohol must operate by

[1] Hayes, *Observations on the Relations existing between Food and the Capabilities of Man to resist low Temperatures.—Am. Journ. of the Med. Sciences,* July, 1859, p. 117.

one of three methods; by checking waste; by a so called stimulant action, or by becoming a material with which to carry on the processes of oxidation and nutrition, and deflecting them from a less to a more healthy action. If now, he argues, it can be shown that alcohol is decomposed within the system, the first and second veiws fall to the ground, since the power to check waste by a coagulation of the bodily tissues or to goad them into greater action is attributed to alcohol only and not to any of the products of its decomposition. From the experiments of Dupré and Anstie he then shows that within certain limits absorbed alcohol is decomposed within the system and but a minute quantity eliminated unchanged — and of this fact there is of course no doubt — and comes to the conclusion that alcohol operates by overcoming the opposition or resistance displayed by the molecules of the body, which, by their coming together, perform the various mechanical movements which the body is capable of making and that this is the "interior work which is performed by heat in the body,"— "the process of forcing the molecules to take up new positions."

Now this is ingenious and part of the reasoning rests on fact but the conclusions seems faulty because the data upon which they are based are mere assumptions. In other words if we would accept this theory it must either be shown that the process of decomposition which alcohol undergoes in its passage through the system is one of rapid oxidation analogous to combustion, or that it imparts force and enables the system to do a greater amount of work. Let us consider each position separately and briefly.

And first, as to the decomposition of alcohol, we are to remember that there are two ways in which it may oxidize; either actively as in its combustion with the production of carbonic acid and water as represented by the reaction:

$$\underset{\text{Alcohol.}}{C^2 H^6 O} + O^6 = \underset{\text{Carbonic acid.}}{2\ C\ O^2} + \underset{\text{Water.}}{3\ H^2O}$$

or passively with the formation of aldehyde and acetic acid as in the manufacture of vinegar, thus:

$$(1)\ \underset{\text{Alcohol.}}{C^2 H^6\ O} + O = \underset{\text{Aldehyde.}}{C^2 H^4\ O} + \underset{\text{Water.}}{H^2\ O.}$$

$$(2)\ \underset{\text{Aldehyde.}}{C^2 H^4\ O} + O = \underset{\text{Acetic acid.}}{C^2 H^4\ O^2.}$$

Now while either of these changes, and perhaps others, may take place, it must after all be admitted that up to the present we know very little of the actual processes by which alcohol is decomposed in the system and that the transformations which it undergoes must be more complicated than shown in these reaction, because none of the products given in either can be found to exist in appreciable or increased quantities in the excretions. The subject is one which is now being investigated by experimenters and on which at present we possess but little reliable information, but it seems more rational to suppose that the aldehyde and acetic acid might escape notice or assume other forms than that the carbonic acid which would be formed in large quantity[1] in the first case, could be eliminated from the system unnoticed or enter into other combinations.

But secondly, as regards the physical results, we are to note that in the case of rapid oxidation either heat or force must be generated, while in the event of passive oxidation but little heat is engendered and therefore but little force evolved. We have seen that alcohol lessens the temperature; now does it impart force or strength — does it enable the body to do a greater amount of work? We hear it said, and this is substantially the ground taken in the paper to which reference has been made, that alcohol not only

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[1] One ounce of alcohol by its combustion furnishes $1\frac{1}{15}$th cubic feet of carbonic acid gas.

supports the system in disease, but enables man to endure fatigue and bear up under protracted exertion. This position, the truth of which is never questioned by many persons, we believe to be essentially false. There are times when alcohol cheers, refreshes, re-invigorates, and in some such cases it does good, but such uses are properly medicinal. It is after fatiguing labor and when, no further exertion being called for, we can guard against the effects of reaction, that alcohol is of service; not while we must still labor and can obtain neither food nor rest. We all remember the story of Franklin and the apprentices, and in this anecdote there is doubtless more of truth than of fiction. I do not believe that the report of travellers and explorers; of those generally who have had sufficient experience to enable them to form an intelligent opinion, will show that the habitual use of alcoholic drinks relieves fatigue or sustains the system when it is exposed to continued hardships. On the contrary I believe that the experience of those who have seen them used in the army and upon ship-board, of those who have observed their effects in polar and in tropical regions, where the greatest fatigue and privations were of necessity endured, will bear out the statement that alcohol has no value as a means of support under such trying circumstances. In confirmation of this view I would call attention to the results observed in the recent English expedition of '75-76, to the polar regions under Captain Nares as stated in a report published in the London *Times*. According to this report there were in the ship six 'teetotalars' and it appeared that these were far less liable than their mates to scurvy or frost-bite. "In a sledging party of seven, which was away from the ship for eighty-four days, all seccumbed to scurvy except Ayles, the only abstainer among them, and Lieutenant Aldrich who was almost an abstainer. Four others of the abstainers are also referred to as having kept their health perfectly, though they took fully their share in the hard work of the expedition. * * * * It may be noticed that the testimony of the whole ship's company — doctors and officers included — is unanimous and conclusive against the serving out of stimulants during the day. They emphatically state that no work can be done upon grog." [1]

Mr. Colvin's experience in the Adirondacks as stated in his *First* and *Second Reports on the Topographical Survey of the Adirondack Wilderness of New York* is entirely in accord with that of Captain Nares. "Not a particle of alcohol or fermented liquor of any kind," he says in his *First Report*, "was used by any member of the party. The result has been subordination, steady work, health and success." [2] And in his *Second Report* he states: "As during previous seasons, the use of alcoholic or fermented liquor of any kind, was prohibited to any one connected with the survey, and neither while engaged in the laborious climbing of the mountains, nor while encountering bitterest storms, or the severity of winter's snows, was any stimulant used or carried. The result has been steady and persistent work and men who had believed stimulants absolutely necessary have expressed a change of opinion. But for the stern and strict enforcement of this rule, fatal accidents might have occurred in the mountain climbing." [3]

Does not then this molecular theory, if I may so call it, fall to the ground if it can neither be shown that alcohol is capable of direct oxidation within the system, nor that it imparts strength to the frame by maintaining th evital processes? Of course these terms are vague and it is difficult to estimate results into which they enter, but so long as alcohol cannot replace assimilable food and does not as we believe, enable man the better to withstand fatigue,

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[1] *Boston Journal of Chemistry*, Feb., 1877, p. 94.

[2] *Op. cit.*, p. 43.

[3] *Op. cit.*, p. 162.

we submit that it rests with those who maintain this theory to show in what manner this 'interior work' is performed.

And now in conclusion if it be said, — is it then rational to suppose that alcoholic liquors have no uses, save in a medicinal sense; that they are utterly uncalled for, and that the testimony in their favor of thousands upon thousands who from time immemorial have made use of them is to go for nothing,— we would say, no, they have uses; such testimony should not hastily be refused consideration. There is a physiological value which substances may have apart from those grosser uses by which our bodies are built up and our inner fires maintained; a value which cannot be estimated in pounds of flesh or degrees of bodily heat, but finds expression in more subtile kinds of matter and forces harder to be measured. That alcohol acts upon the nervous system, stimulating it to action, there can be no doubt, and do we not all believe that mental influences affect the bodily functions. Our only endeavor this evening has been to show that it cannot logically be claimed as a food in the ordinarily accepted sense in which that term is employed, but that it may have less material uses and produce other and beneficial results we would not for a moment deny. Peculiar idiosyncrasies have much to do with its effects and while there are those to whom even in small quantities it is harmful, there are many others, who, using it as the other good things of this life should be used, in moderation, may receive no injury and perhaps derive from it not only enjoyment but benefit. Let it be remembered that even if in a state of perfect health the human system has no need of stimulants, there are few, if any of us who are in possession of so valuable a legacy; that no one at present lives upon the simple fare which supported his early ancestors, and that higly civilized beings require a greater variety of substances for their sustenance than brutes. We indulge in many luxuries which in themselves are rather harmful than beneficial, and yet we would not willingly be deprived of them, even did we think we might live a year or two longer by our abstemiousness. Alcoholic drinks belong to this class of substances, of which they are undoubtedly the oftenest abused members. So long, however, as we continue to live as, in most respects, do those of the nineteenth century, total abstinence in this respect alone seems, to say the least, inconsistent, if not uncalled for.

THE FIRST VISIT OF AN AMERICAN SHIP TO JAPAN AND ITS RESULTS.

By George R. Howell.

[Read before the Albany Institute, May 21, 1872.]

Thirty years ago thirty millions of people were living in the empire of Japan almost as much isolated from the rest of the world as if they had been denizens of the planet Jupiter. A solitary Dutch ship freighted with the products of the industry or soil of Europe and the large islands of the Pacific, semi-annually sailed from Batavia for traffic with this sea-girt empire bound, however, not for the harbor of their metropolis, but for the inferior city of Nagasaki on the outposts of their realm; and this comprised their commerce with the western world. They had attained a high degree of civilization. They had a complicated form of government, and their country was divided into grand divisions, provinces, districts, cities and towns. They tolerated systems of religion not intolerant themselves. Printing had been in use for six hundred years. Japan was full of books, often profusely illustrated and no branch of literature was neglected. Poets, novelists and historians had no lack of readers. Public schools free and accessible to all are said to have existed, maintained at the expense of the state. Such was the country whose barriers the advent of an American sea-captain, on a mission of mercy, was to smite down for the introduction of western civilization and commerce and of Christianity.

The first American vessel to visit the coast of Japan was the Morrison fitted out by an American mercantile house at Macao in 1837. The object of this voyage was to return seven Japanese rescued from ship wreck and brought into Macao, and at the same time to lay a foundation for trade and missionary effort. But the rescued sailors were not permitted to land and on communication with the capital, the vessel was driven off by a vigorous cannonade and returned to Macao ; not one of her objects having been attained.

The next attempt, which is the subject of this paper, was more successful. It was made in 1845 by Capt. Mercator Cooper, in the whale ship Manhattan of Sag Harbor, L. I. Capt. Cooper was born in Southampton, L. I., in the year 1803. When a young man he engaged in the whale fishery and rapidly rose to the command of a ship, and at the time of his visit to Japan, it would be difficult, from the evidence of seafaring men to find his superior in seamanship and in a thorough knowledge of all the minute details of theory and practice that pertain to his profession. The first week in April, 1845, found the Manhattan off St. Peter's, a small uninhabited island, a few leagues to the southeast of Niphon. Upon landing here to capture some turtle discovered on the shore, they found a number of Japanese sailors who had been shipwrecked with no means of returning to their homes. Capt. Cooper communicated to them by signs his willingness to take them to Japan and accepting the offer they embarked and the ship took up her course for Jeddo. Aside from feelings of humanity, and besides a strong personal desire to enter a port and behold the mysteries so long guarded from the world, Capt. Cooper hoped by this act of kindness to make a favorable impression upon the Japanese in respect to the civilization of the United States and its friendly disposition towards them. These considerations led him to steer boldly for the capital, notwithstanding the well known regulations prohibiting the entrance of all foreign vessels into that harbor.

As if to add emphasis to this errand of humanity, on the second day out from St. Peter's a dismasted Japanese junk was discovered in a sinking condition from which eleven other sailors were rescued and informed of the purpose of the Americans to restore them to their homes. Arriving on the coast of Niphon he despatched two of the natives he had rescued with a message to the emperor announcing his intention to enter the harbor of Jeddo. In due time he passed through the straits or channel leading from the open sea to the bay and entered the bay itself deep within which the city is situated. Here a barge met him, coming from the city, the commander of which notified him of the arrival of his messengers and the emperor's permission for him to proceed further up the bay. He was directed to anchor for the night under a certain headland. The next morning the ship was surrounded with hundreds of boats manned with oarsmen and men-at-arms liberally furnished with swords and spears. These boats formed in several long lines, were made fast to each other and to the ship by ropes and awaited the signal to advance. The Manhattan then hove up her anchor and amid the shouts of the multitude of boatmen was towed up to a new anchorage within a few miles of the city. Here he was visited by large numbers of the Japanese of all ranks, but neither himself nor any of his crew were permitted to land themselves.

Conversation with the Japanese officials was carried on through a Dutch interpreter. The frank and manly bearing of Capt. Cooper, as well as his personal kindness to his passengers, won the confidence and respect of the representatives of the government, and in particular of the governor of Jeddo who had many interviews with him. During his stay this officer treated him with marked courtesy and on his subsequent visit to New York as one of the principal personages of the Japanese embassy, made particular inquiries of his welfare.

The prohibition to land was no paper blockade. On the first morning after the anchoring of the ship, the spectator soon saw there was a well ordered plan developing in the movements of the hundreds of boats flashing through the harbor. About a hundred feet from the ship, and perfectly encompassing it, a line of boats was formed, lashed together, their sides touching, and their sterns toward the Manhattan. In the midst of this circle, between the ship and the city, a large junk was stationed, in which were the officers of the guard. Outside of these, at the distance of about a hundred feet was another circle of boats, not so numerous, and beyond this, a third circle still more scattering, but each circle made complete by passing a hawser around from boat to boat, to which they were all fastened. Hundreds of boats filled with men in gay uniform, gorgeous banners of strange and unknown devices, and thousands of lances, naked and glittering in the sunlight, or sheathed in lacquered stuff, made a brilliant spectacle by day, and transparencies and lanterns in countless numbers and of all fantastic shapes, dancing in the movement of the waves, furnished a still more brilliant scene at night. Within that cordon of boats floated for the first time in those waters the American flag.

In the conversation with the governor of Jeddo, the whole subject of the entry of the American vessel into their harbor was discussed. Capt. Cooper was informed that the only reason of his being allowed to remain in the waters of Japan was because the emperor felt assured he could not be a "bad-hearted foreigner," from the fact that he had come so far out of his course to restore poor people who were strangers to him to their homes. He was repeatedly told that the emperor "thought well of his heart," and consequently orders had been forwarded to treat him with great attention and supply all his wants. The day before his departure the emperor sent him his autograph as a token of his respect and consideration. But that the visit might not be repeated, even as an errand of humanity, Capt. Cooper was instructed to leave with the Chinese or Dutch any other Japanese should he chance to rescue them from similar peril. And on learning his intention to visit Petropaulowski and afterwards Holland on his voyage homeward, these facts were communicated to the emperor, who had the following open paper sent to Captain Cooper which he was to exhibit wherever he mentioned his visit that it might not be regarded as a precedent for all who chose to follow.

"I am informed, by the mouths of some shipwrecked persons of our country, that they have been brought home by your ship, and that they have been well treated. Now it is our law, that such persons should not be received from the hand of foreign countries, except China and Holland. But in the present case, we shall make an exception, because the return of these men by you must be attributed to your ignorance of this law. In future Japanese subjects will not be received in like circumstances, and will have to be treated rigorously when returned. You are hereby advised of this and that you must make it known to others.

"That provision, firewood, water from the long time spent on the voyage are scarce upon the ship, this is heard and these things are granted.

"On receipt of this order the ship must speedily depart, and not remain near by this land, but actually return to its own country."

The Manhattan remained in the harbor four days, during which time the captain received the supplies he needed, for which no compensation would be taken. When the ship was sufficiently recruited and ready for sea, adverse winds presented no impediment to the governor. The guard boats broke up and wheeled again into long lines and towed the Manhattan out of the bay and channel till she gained a sufficient offing, when she set her sails and resumed her voyage.

That this visit made a great impression on the Japanese mind or rather on the disposition of the government towards the United States seems to be evident. It doubtless did much to prepare the way for subsequent negotiations by another citizen of this state, Townsend Harris, and for the success of Commodore Perry's expedition sent out by our government to establish a treaty for trade and commerce with this empire.

Capt. Cooper died April 24, 1872, at Barranquilla, Colombia, S. A., where he had gone a few months previous with the hope of a restoration to health.

ON LIGHT IN SOME OF ITS RELATIONS TO DISEASE.

By George T. Stevens, M.D.

[An address read before the Albany Institute, Dec. 19, 1876.]

So important, so indispensable, in fact, is the agency of light to life that Lavoisier was warranted in the assertion that, "without light, nature were without life and soul; and a beneficent God, in spreading light over creation, strewed the surface of the earth with organization, with sensation, and with thought."

To speak of such an agency in relation to disease as cause and effect may appear paradoxical, especially when we remember that, in the recent great advances in sanitary subjects, in few if in any other directions have the efforts of the sanitarian been so well rewarded as in letting light into dark places. Like the perturbed spirits which of old were supposed to be doomed to walk the night, but which vanished at the approach of dawn, disease and death have often fled before a beam of light which modern science has admitted into some dark corner.

It is said that soldiers quartered on the sunny side of a barrack possess great advantages in point of immunity from disease over their comrades who occupy the shady side; and experience in large hospitals seems to justify the conclusion that patients confined by lingering and debilitating diseases do best in the wards most exposed to the sunlight.

If light, then, is essential to life, is a destroyer of ferments and contagions, and is conducive to the recovery of the sick, how can it be regarded as a cause of disease? We may in a general way reply that any agent which is powerful for good is also potent for evil — that there is no light without its compensating shadow. But to be more specific, and to come as directly as possible to the subject of discussion to-night, let me say at once that I propose only to consider briefly the important *role* which light plays in producing or in predisposing to certain classes of disease, as it passes through the transparent media of the human eye.

It will be necessary, before advancing to the main discussion of such a subject, to review briefly some elementary principles which are well established in regard to the classes of troubles which will engage our attention, as well as to glance hastily at some points in the physiology of vision.

We frequently meet with affections of the conducting nerves in which pains, convulsions, loss of sensibility, or other unnatural phenomena exist, but in which the pathologist, when he examines the affected nerves, or their surroundings, or even the more central parts from which these nerves are derived, finds either no appearance of morbid change, or, if any such changes are found, they are not constant and cannot be regarded as characteristic. Such affections are called functional nervous affections, or neuroses. Among them are neuralgia, the more common forms of headache, epilepsy, chorea, more commonly called St. Vitus's dance, hysteria, and insanity. Pathologists have exercised great patience and industry in vain endeavors to find some constant organic condition which should lead to a better understanding of some one or all of these distressing and often alarming affections.

Failing in this, many able and earnest observers have devoted themselves to the careful study of the history and attending phenomena of these neuroses, with the result of collecting and arranging a great many most valuable facts. Among the most important and most interesting facts relating to the cause of these neuroses are those which show that there exists in a very large proportion of them a predisposition either hereditary or acquired by the individual subject to them.

This predisposition to functional nervous affections is well established by the observations of careful and candid investigators, and is verified by the daily experience of many physicians. Persons possessing this unfortunate predisposition are liable from slight immediate causes to such troubles as neuralgia, headache, epilepsy, hysteria, insanity, and even consumption. In a large proportion of instances this predisposition is hereditary; and this inherited relationship to disease, while it has been carefully investigated by a few of our most able observers, has by the greatest number of practitioners of medicine been altogether too much overlooked. One who will investigate these hereditary tendencies will be surprised to find in how great a proportion of the victims of nervous trouble there is a family history of kindred affections. Thus a person who is an habitual sufferer from neuralgia may remember, when questioned, that one of his grandparents was also neuralgic, that his mother was a victim of oft-recurring nervous headaches, that his aunt has hysteria, and his cousin possibly epilepsy; and that, of his brothers and sisters, some have headaches or neuralgia, and others are called nervous people.

Not long since I saw a boy of sixteen, who for ten years has been subject to epileptic fits. His mother, who was for many years subject to similar fits, died in early womanhood; her father, who is still living, has during the last few years been epileptic; and by an interesting coincidence, on the day that I first saw the boy I also met a cousin of the mother, a resident of a distant town, who was himself a sufferer from this terrible malady, and whose mind had already become enfeebled by the disease.

Here is another instance, and one which, with slight variations, may be met with almost daily in the practice of many physicians. A gentleman from a neighboring city has always suffered from a general nervous irritability; he has been one of the class of excessively nervous people; his grandfather had always a great deal of neuralgia; but his father, who observed very strict habits of life, and whose occupation kept him much in the open air, had no nervous trouble. Three brothers have suffered terribly from neuralgia, and one, who for many years was subject to functional nerve-troubles, has now an organic disease of the nervous centres. He has one sister, who is subject to oft-repeated nervous headaches.

Great attention has been paid to this predisposing tendency, both hereditary and spontaneous, by many of the most learned members of the medical profession; but, unless the hypothesis which I present to-night explains this peculiar and unfortunate tendency which forms the unwelcome inheritance of so many families, nothing has ever been known of it except its existence.

There is a peculiarity about this predisposing tendency which should be noted in passing — that persons affected with one form of functional nervous disturbance at one period of life, are liable to suffer from some other form at a later period. Thus, one who in childhood suffers from chorea (St. Vitus's dance), will generally, in later life, be the subject of severe recurring headaches, of neuralgia, or perhaps of epilepsy. It is a commonly-observed fact with physicians that hysterical girls usually become nervous women, subject to periodical headaches.

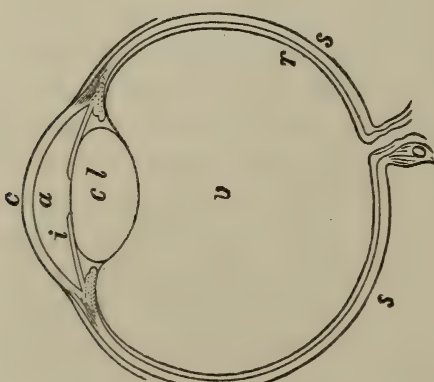
From such facts as these we may logically conclude that the predisposing cause of this class of troubles is a permanent one, that it often descends from parent to child, and that it is usually the same in different persons, and for different forms of functional nervous diseases.

About five years ago my attention was drawn to a singular and what seemed a constant relation between chorea, or St. Vitus's dance, one of the most characteristic and clearly-defined forms of nervous affections, and certain peculiarities in the manner in which light entered the eyes of the patients; and I was struck with the remarkable fact that intractable cases of chorea yielded when the conditions for correcting the eye-troubles were complied with. These circumstances would have led me to suppose that both the chorea and the visual defect were the result of a common cause, and that the remedy for one happened to be the remedy for the other; but, as the eye-troubles were not diseases, but, simply natural peculiarities, which caused these patients to see at a disadvantage, that these conditions were congenital, and in many instances simply family features, as characteristic as the form of the nose or the shape of the head, it became evident that, if any relationship existed between the eye-feature and the nervous disturbance, it must be the relation of cause and effect, and that the permanent and inherited feature must be the cause. Further investigation revealed the fact that in other forms of nervous troubles similar relations were formed. As those in whom I had discovered these relations were in almost every instance patients on account of a particular class of affections, I thought it best to search among the patients of those who were engaged in more general practice. Accordingly, the kind offices of many of my medical friends were brought into requisition to furnish the material, from general practice, for this investigation; but the results were the same as before. Hence I was led to conclude that, as a general rule, certain forms of visual defect and functional nervous diseases were in relation to each other as cause and effect.

Before proceeding further let us briefly review some points in the physiology of vision. When rays of light fall upon the surface of a healthy eye, they pass through the transparent portions, to reach the retina, which is the extremely delicate membrane constituting the inner lining of the posterior part of the eye, and is the sensitive surface on which the image is formed. But, in passing through these transparent portions, to reach the retina, the rays of light are bent, or, in technical terms, are refracted, so that they may be brought to a focus. In this diagram is represented the form of a section of an eye, showing the arrangement of the parts for refracting the rays of light.

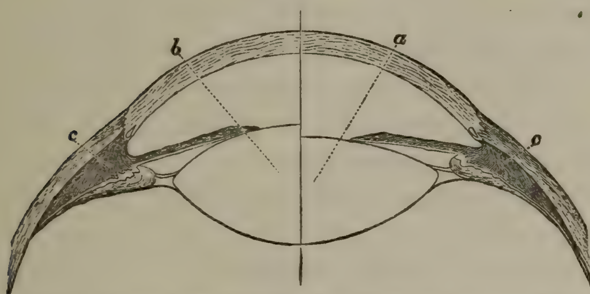
The tough opaque shell of the eye, *s* (*sclera*), maintains its form, and holds in place the transparent humors which fill up its space. In front, this shell is changed to a transparent window, *c*, the cornea. Light from a luminous object passes through this transparent substance, and then through a body called the crystalline lens (*c. l.*), reaching at length the retina *r*. In order to form an image here these rays are refracted so as to bring them to a focus upon the retina; but, as objects are seen at different distances, some provision must be made for changing the focus of the eye. This you know is done in the opera glass by turning the screw, so as to throw the lens forward for near objects, and backward for distant ones. In the eye this change of focus is effected by the crystalline lens.

FIG. 1.



This lens is hung in its place by a delicate substance, which attaches it to an annular ring of muscular fibres, called the ciliary muscle (*c*, Fig. 2). When this ring of muscle contracts, the lens, by its elasticity, becomes thicker and more convex, and thus the rays passing through it are more strongly refracted, and near objects are distinctly seen.

FIG. 2.



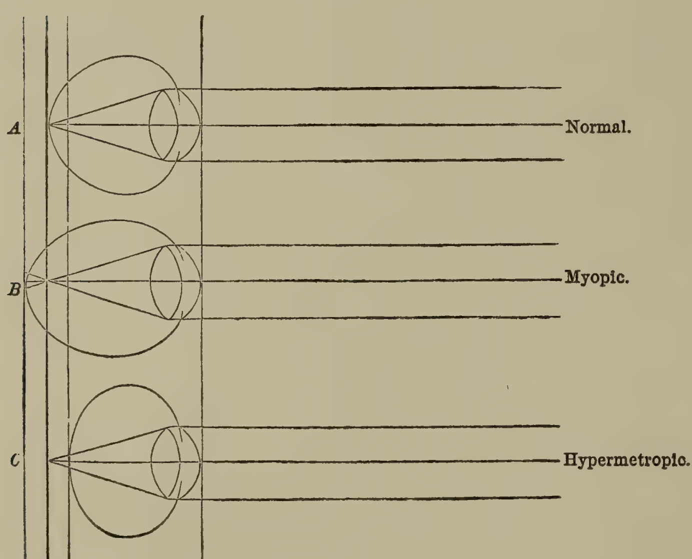
(Fig. 2 shows the condition of the lens under these different circumstances. At *a* the ciliary muscle, *c*, is in repose, the lens is flattened, and the eye accommodated for distant objects. At *b* the ciliary muscle *c*, is in a state of contraction, the lens is thickened, and is accommodated for the near point.)

This faculty of changing the focus is called the faculty of accommodation, and is in constant use as we turn our eyes from near to distant objects. In an eye constructed on as strict optical principles as eyes should be, this change is very easily produced, and vision is perfect at all points, with only the slight exertion of nerve and muscle force which can be maintained without fatigue or consciousness of exertion. In such an eye — which, because it is the best form of an eye, we will call a normal eye — the slight tension of the ciliary muscle which is necessary for near vision may be kept up for many hours with very little if any inconvenience. But we know that a constant tension upon a muscle or set of muscles, if it be even but a little more than nature intended, soon produces fatigue. A pound-weight is but little for any one to hold; but let any person hold a pound weight in the palm of his hand while he bends the elbow so that the forearm is at right angles with the arm, and in a short time, varying from one to several minutes according to the muscular power of the arm, fatigue will be experienced ;[1] and, if the experimenter is not accustomed to much exercise of the muscles of the arm, a rather painful sense of exhaustion may continue for a considerable time.

Now, it not unfrequently happens that such a constant and unnataral tension is forced upon this ciliary muscle which regulates the accommodation. For all eyes are not constructed upon the most perfect plan : some are too long some too short, and some have not uniform refractive surfaces in different meridians.

The diagram here shown (Fig. 3) will assist in understanding this.

Fig. 3.



[1] Donders on Asthenopia.

In the figure at *A* we see rays from a distance, parallel rays, refracted in such a manner as to be brought to a focus at the retina. This is the normal eye. At *B* the rays at the same distance from the cornea have not reached the retina, but cross over and are separated before reaching it, so that a clear image of distant objects is not formed. This is the near-sighted eye, and is technically called a myopic eye. It is too long. At *C* we have the reverse of this condition. Here the eye is too short, and the diagram shows that the rays when they reach the retina are not yet brought to a focus, but could they pass through would unite in a focus behind the eye. This is the eye commonly called oversighted — technically, hypermetropic.

The oversighted person, in order to see even distant objects clearly, must begin to exert the faculty of accommodation. By contracting the ciliary muscle, such a person is enabled to see a distant object with either perfect or comparative distinctness. The force, if the eye is not much shortened, may not be more than the person with the normal eye exerts when he looks at a near point; but we see that, as the hypermetropic person brings the object near his eye, he must exert much more than the natural force in order to bring the rays to a proper focus. As this muscle is forced to contract by nervous influence, it will be seen that here is a source of nervous exhaustion, especially if the muscle is forced to a continued contraction, as is the case when such a person reads or works at needle-work for a considerable time.

Thus it will be seen that, while normal eyes are always at rest when accommodated for distance, and only slightly exerted when accommodated for the near point, hypermetropic eyes are never at rest except when closed; and that, in viewing near objects, an excessive effort is required, and that this excessive effort is increased in proportion as the hypermetropia is more considerable.

Nor is this the only disadvantage to which the hypermetropic eye is subjected:

As the object viewed approaches, the eyes converge. This may be easily seen by any one who will watch the eyes of another before whom he moves some small object backward and forward, while the person observed fixes his eyes upon it. This act of convergence is accomplished by a long muscle which lies at the nasal side of the eyeball, and which, by contracting, draws the eye toward the nose.

It will be seen that the effort of accommodation effected by the ciliary muscle within the eye, and the effort at convergence effected by the long straight muscle without the eye, are simultaneous; but they are also exactly proportioned to each other, so that a pair of normal eyes accommodated for twelve inches is also converged for twelve inches. In a pair of hypermetropic eyes, however, this balance is lost, and a person having such eyes who accommodates for twelve inches requires an exertion on the part of the ciliary muscle equal to accommodating the normal eye for a nearer point — we will say, for six inches. In such a case, a corresponding convergence of the eyes will take place; and so, while the eyes are accommodated for twelve inches, they are converged for six. Confusion of nervous and muscular action is the result; there is disappointment of all the parts involved in the action, and in all affairs of muscles, of nerves, or of the heart, nothing is so depressing or distressing as disappointment.

To this confusion of nerve and muscle are due the pain, nausea, and vertigo, of the youth who attempts to read with his grandfather's spectacles, and this is the constant state of confusion of nerve and muscle in cases of erroneous refraction of the eyes. Let any one who imagines this nervous confusion to be of slight importance, if he have normal eyes, and has not reached the age when strong convex glasses are demanded, attempt to read for half an hour with magnifying spectacles of sixteen or eighteen inches' focal length, or let him study the landscape for a considerable time with a pair of glasses adapted to a near sighted person, and he will soon, by his aching eyes, his nausea and vertigo, acknowledge that here is a cause of nervous disturbance of no slight or insignificant pretensions; and when we remember that the immediate cause of convulsions and other alarming nervous disturbances is sometimes apparently trivial — such as a hastily-devoured meal or the taking of even a small amount of food which is illy digested — we cannot fail to perceive that this cause of irritation, prolonged through all the experience of the individual, must be abundantly potent to produce either of the functional disturbances of which we have spoken.

A form of error of refraction not yet referred to is a combination of other forms, and is called astigmatism, which means *without a point.* In this anomalous condition the refracting surfaces are different in different meridians of the eye, so that no exact focus can be formed, and there is an irrepressible conflict going on to correct the error, which can never be corrected without external help. This is a most vexatious cause of irritation and prolific source of nervous disturbances.

We are now, I think, prepared to bring our two classes of facts together and see if they will fit.

We have seen, in the early part of this discussion, that the tendency to nervous affections often runs in families, and that the nervous disturbances manifest themselves in different forms in different members of such families, what is sometimes called a "neuropathic predisposition," exists.

Now, it is also true that the faults of refraction are the unfortunate heritages of many families. Indeed, these refractive conditions are as much characteristic features, depending as they do on the form of the eye, as the form of the nose, the eyebrow, or the cheek-bones; and, as we see family likenesses prevailing among those who are related by ties of consanguinity, so these peculiarities in refraction are family inheritances.

Surely, it would be a most interesting and important fact were we to find that these nervous predispositions and these refractive evils were to be found in the same families, and yet this is precisely what I have proved in a large number of instances.

Let me give you one or two examples: A lady, who has for years been the subject of severe headaches, coming on almost every week, and continuing from one to three days, has one brother and two sisters living; a third sister died a few years since. The brother has from boyhood suffered from headaches; her elder sister was for years subject to convulsions, which deprived her of consciousness for a time, varying from a few minutes to half an hour, and which occurred about once in three or four weeks; these were possibly epileptic fits. The other living sister has always been subject to neuralgia and nervous headaches, and the sister who died was, like the last, a victim of neuralgia and headache. The eyes, both of the lady first mentioned and of the sister who had convulsions, were found, on testing, to be hypermetropic in a high degree, and from them it was learned that both of the other sisters and the brother were forced to put on old people's glasses before they were twenty-five years old, rendering it almost absolutely certain that they were all hypermetropic, and that this peculiar form of anomalous refraction was a family characteristic.

A medical friend complained of his oft-recurring nervous headaches, which he said he inherited from his father. He was induced to have the refraction of his eye tested, when it was found that he had astigmatism. An elder sister, who during several years of her early life, was a victim of chorea, but of late a sufferer from intense neuralgia, and from that distressing form of headache called hemicrania, was found to have astigmatism in a high degree; and her only son, a boy sixteen years of age — who is, like his grandfather and uncle, a subject of headaches, recurring so frequently as to interfere with his education — is, like his mother and uncle, astigmatic. I might mention some scores of family histories, of which these are fair examples.

We are all aware of the fact of this inherited tendency to disease, and yet no person in his senses supposes that a disease like epilepsy or neuralgia is directly transmitted from one generation to another; and this subject of hereditary tendency has always been one of the great mysteries of medical science. But facial features are directly transmitted from parent to child; and, if the form of the eye can constitute an important cause of a class of diseases, the hereditary tendency to these diseases, if it exists, is readily explained.

It would be of little service to a person suffering from a nervous affection to assure him that he had an astigmatism or an hypermetropia, or that he was unequally myopic in the two eyes, unless science offered a relief to these unpleasant peculiarities. Fortunately, modern science is fully prepared to afford the relief demanded.

During the last few years, under the leadership of men of the highest genius, like Prof. Donders, of Utrecht, a class of medical men has brought the science of correcting anomalous refractions of the eye to a perfection which is truly wonderful. Formerly, when a person reached the age of forty-five or fifty, and found that he was, in the language of a medical friend, "forced to trombone his newspaper" in order to find the least uncomfortable distance at which to hold it, sought the nearest jeweler, bought a pair of spectacles which seemed nearest right, but which were often the most completely wrong, concluded that he was growing old, and losing his power, and so, with as good grace as possible, submitted to the great cross and humiliation of his lifetime.

Now, however, we know that more than one-fifth of all the children in our schools have anomalous refractions, and that the wearing of glasses for the correction of these errors is neither an indication of age nor of foppery, but a sensible acceptance of the great benefits which science confers in such cases. No longer do those who are well informed in respect to such troubles seek a shop where glasses are kept on sale; for one might about as well, if he desired his photograph taken, request his neighbor to sit for him, or search through the show cases of the photographer for a good picture for himself! He must sit for his own photograph, and he must sit for his own glasses, and often the highest scientific knowledge of the surgeon and the most consummate skill of the artisan are brought into requisition for the correction of a refractive error, of the very existence of which the patient is scarcely aware. Hitherto, this knowledge of the surgeon and skill of the worker in glass have been almost exclusively of service when the patient complained of visual troubles. Henceforth, I am convinced that these visual troubles will be sought for in order to afford relief for and protection against many nervous affections.

It is said that "the proof of a pudding is in eating it," and the crucial test of a doctrine such as I have presented is its applicability in the management of the affections of which we have spoken. Does the correction of the eyes of patients relieve their nervous symptoms? I answer unhesitatingly, yes. This is no place to relate cures in medical practice, but, after a sufficiently extended and careful series of observations continued during more than four years, I can safely prophesy that this principle will be found of more universal application and more successful in its workings than any which has been advanced for the mitigation of this class of affections.

Many hundreds of persons suffer the strain upon the eye and upon the nervous system, as the result of these visual troubles, who are entirely unconscious of any defect of sight.

A robust-appearing German friend, who had adopted glasses for the correction of refractive errors on account of a nervous difficulty, when asked to describe the effect of his glasses upon him, replied: "When one who has a tight coat that he has worn so long he don't know it is tight, because he is used to it, gets another coat which is big enough, then he knows how he feels so much better. That is the way with my glasses. I did not know how bad I feel before, until I got my glasses and felt so much better."

How often do we see children of our schools, frequently the brightest and most ambitious of their class, struggling with irritable nerves, at a disadvantage in their studies, laying the seeds of future trouble, and often, as the time comes for selecting a pursuit in life, forced to abandon a chosen course of studies, because the confinement at such work is too great a strain upon them! I look forward to the time when these children who, from this single peculiarity, are placed at so serious a disadvantage in the struggle for life, shall find the relief that science is ready to afford them, and which would remove the weight that would otherwise prove a serious hindrance in their course.

We may compare the heart of a man to the main-spring of a watch, while the delicate nerves which control the accommodation of the eye may be compared to the fine hair-spring of the time-keeper. It matters little how often we wind the watch, and thus supply tension to the main-spring, if the delicate hair-spring is not well fixed in its place — if it is a little too long or a little too short — our watch is out of time, and cannot be made to run true; but, regulate the tension of this extremely delicate spring, and the movements of the watch become perfect and reliable.

So the heart may supply the force necessary for the perfect working of the human machine; but if the tension upon these delicate nerves is not well regulated, there may be such nervous disturbances as seriously to impair the comfort and usefulness of the individual.

There may be a broken cog or an imperfect wheel in the time-keeper, which, in spite of main-spring or regulator, will sooner or later stop the watch; and, in the human machine, there may be gross organic lesions which will disturb or destroy its working; but, excepting these, and other things being equal, the boy or the girl with the best heart and the best eye is most completely armed for the battle of life.

THE HYDRAULIC BEDS AND ASSOCIATED LIMESTONES AT THE FALLS OF THE OHIO.

By James Hall.

[Read before the Institute December 4, 1877.]

At the Falls of the Ohio and adjacent localities, the lowest beds of the limestone formation are marked by the presence of *Halysites catenulatus*, and for a long time have been locally known as the "Catenipora beds." This Silurian limestone is succeeded by the great coral-bearing Devonian limestone, which is everywhere, in that part of the country, a well defined geological horizon; and though the higher beds of the formation are distinguished by the presence of other fossils than corals, there is no marked physical change from the base to the upper stratum which is characterized by *Spirifera acuminata*. The whole is more generally recognized by its numerous corals, and the genera Favosites, Michelinia, Zaphrentis, Heliophyllum and Cystiphyllum are prevailing forms.[1] This limestone is succeeded by beds of an argillaceous magnesian limestone, known as the "Hydraulic limestone," which gradually merges above into thin, slaty beds, some of which are highly siliceous, and these are followed by what is known as the "Encrinal limestone;" the whole terminated above by the black slate. This entire limestone formation above the "Catenipora beds" has been generally, if not universally, recognized as of the same age and as the western extension of the Upper Helderberg group of New York (representing all that was originally included by Eaton under the de-

[1] It was from the presence, in this locality, of numerous species of corals, identical with those of the New York formations, that, in 1841, I recognized these limestones as of the same age.

signation of Corniferous limestone and Schoharie grit). I have accepted and advocated this view of the age of these formations, which seemed to be sustained by large numbers of identical fossils from the two distant regions; and I believe that their relative age has not, up to the present time, been formally called in question.

As might naturally be expected, the subdivisions recognized in the east and in the west do not always coincide, but it is usually quite possible to correlate these different members by a comparison of their fossil contents. The main limestone (the great coral reef, comprising the Onondaga and Corniferous limestones of the New York system) seems to have been originally unbroken, at least from the valley of the Hudson nearly and perhaps quite to the line of the present valley of the Mississippi. It is traceable in unbroken continuance from the Hudson to the Niagara rivers, and through Canada West to Lake Huron, and thence into Michigan; while in a southwesterly direction are the outcrops on the two sides of the Cincinnati axis, extending through Ohio and Indiana, and thence into Kentucky, where it gradually thins out. During the formation of this remarkably extensive coral reef, there could have been no great change in the conditions of the ocean; for not only do these corals indicate an undisturbed and luxuriant growth, but the same genera and the same species prevail over a large part of the above area. It is only in the superjacent beds that we may look for changed conditions, which have given origin to the different terms used to designate the subdivisions of the formation in different parts of the country.

In New York we have the following members of the series, between the Marcellus shale and Oriskany sandstone:

1. Marcellus shale.

Upper Helderberg group. — The Corniferous limestone of Eaton.[1]

2. Limestone with Ichthyic remains (bone bed). . . .
3. Cherty beds, with species of Loxonema, Pleurotomaria, Bellerophon, etc. . . . .
4. Corniferous limestone. . . . . . .
5. Onondaga limestone (the great [illegible] limestone). . . .
6. Schoharie grit.

7. Oriskany sandstone.

In the state of Ohio, Dr. Newberry, recognizes the following:

Hamilton shale.

Hamilton limestone.

Corniferous group.
- Sandusky limestones.
- Delhi bed.
- Columbus limestone.

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[1] In the arrangement of Prof. Eaton, all the limestone formation between the Schoharie grit and Marcellus shale was termed "Corniferous limestone"— no subdivisions being recognized. In the reports on the Geological Survey of New York, the subdivision into Onondaga and Corniferous limestones was made for the convenience of reference, and on account of the character of the prevailing fossils in the two members. Further investigation has shown the existence of a peculiar Cherty bed containing characteristic fossils, and also a Calcareous bed with remains of fishes; both of which are distinct from the Onondaga and Corniferous beds below, but neither of them, apparently, co-extensive with these lower members of the series. The characteristic fossils of the Corniferous or Onondaga limestones do not occur in either of these higher members. It is true, that the extent and value of these beds have not been determined; but they repre-

In 1847 Messrs. Yandell and Shumard published the following table of the formations at the Falls of the Ohio, as determined by Dr. Clapp of New Albany:

Upper limestone.	Subcrystalline limestone, 8 ft., Water limestone, . . . 12 ft.,=20 ft.
Shell limestone.	Subcrystalline limestone, with many characteristic shells and trilobites, and a few corals, ... 16 ft.
Coralline limestone.	Upper Coralline, to Catenipora [beds], composed mostly of corals, and destitute of shells . . . . 20 ft. Lower Coralline, corals mostly different from those above, and very few shells; the upper part alone visible on the Falls, ... 20 ft.,=40 ft.

They also describe these several beds, giving certain fossils in each as determined by them. They recognize the lower beds as equivalent to the Niagara group of New York, and cite several species of fossils as identical with the New York forms. The beds above, with their fossil contents, are treated in some detail, and the waterlime is described as resting on the Pentremital stratum, bearing *Pentremites* (= *Olivanites* = *Nucleocrinus*) *Verneuili.* The waterlime is represented as covered by a siliceous bed containing Chonetes, Loxonema, "a small Orthoceratite," etc., and immediately above this comes a granular limestone which contains numerous species of Encrinites and a few corals and shells. [From these, and from other observations of earlier and later date, the limestones of the

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sent the deposits and the fauna of a changed condition of the ocean bed supervening the coral growing period, and are entitled to recognition in any critical subdivision of the series.

Falls of the Ohio have been considered the equivalent of the Corniferous limestone (= Onondago and Corniferous limestones), and generally of the limestones of the Upper Helderberg group of New York.]

These authors recognize the black slate, above the limestone of the Falls, as having a thickness of 104 feet.

At a later period Major Sidney S. Lyon published a table of the "*Stratigraphical Arrangement of the Rocks of Kentucky*," in which he gives the following table of the beds at the Falls of the Ohio and vicinity :

q Black slate [=Genesee slate].
r Encrinital limestone.[1]
s Hydraulic limestone.
t Spirifer bed.
u Nucleocrinus bed.
v Turbo bed.
w Coral beds.
x Catenipora beds [= Niagara formation].

The beds from *r* to *w* inclusive have been regarded, I believe, by all geologists, as the equivalent of the Upper Helderberg limestones of New York; and without critical examination of rocks in place, or a careful comparison of the fossils contained in the several beds, I have heretofore accepted this determination, and aided in the dissemination of this opinion.

This view seems in fact to have been unavoidable, since the fossils from the limestones at the Falls of the Ohio have been collected and widely distributed throughout the country without reference to the successive beds of the formation from which they have been obtained. More recently my attention has been called to the vertical distribution of the species in these rocks, and during the printing of the early pages of volume v of the Palæontology

[1] In this table, the thin-bedded or slaty siliceous limestone, with Chonetes, and many other fossils, is not distinctly recognized, although it is really an important member.

of the State of New York, I became doubtful of the real identity of the higher beds with the New York limestones; and in considering the numerous species of characteristic Hamilton fossils which they contain, I became satisfied that there was room for farther inquiry and comparison.

In the month of August of the present year (1877), during a low stage of the water in the river, I had an opportunity of examining the waterlime and superincumbent beds, as well as the coral-bearing beds beneath.

A considerable portion of the waterlime beds consists of an argillaceo-magnesian limestone, destitute of organic remains. The upper part contains many specimens of *Spirifera euruteines*, and the thinly-bedded, slaty and siliceous strata above it are charged with numerous fossil species, the most abundant of which is the *Chonetes Yandellana ;* but many other known forms occur, and the entire facies, when critically viewed, presents the general aspect of the fauna of the Hamilton group. The encrinital bed above these thin layers contains numerous Crinoidea, all of which are congeneric with Hamilton forms, and many of the species are identical with those known in that horizon in the state of New York.

The following tabulated list of species from the Devonian limestones at the Falls of the Ohio, though incomplete, will serve for a comparison with the Upper Helderberg and Hamilton groups of New York. The species indicated in the first column are known species of the Upper Helderberg limestones of New York,[1] and occur at the Falls of the Ohio in beds *t*, *u*, *v* and *w* of Major Lyon's series (p. 173). All the species which pass upward into the succeeding hydraulic and encrinital limestones are likewise known to pass from the limestones below into the Hamil-

[1] *Pleurotomaria imitator, Turbo Shumardii* and *Dalmanites Calypso,* have not yet been observed in this formation in the state of New York.

ton group in the state of New York. A considerable number of species occur in the Louisville upper limestones which are not known in the Hamilton group of New York: but these are largely among the Crinoidea, where there has been no opportunity for a critical comparison of specimens. The corals, with a single exception, are omitted from the list, since they are almost in all respects identical with those of the Upper Helderberg limestones of New York, and their mention is quite unnecessary for the present purpose.

List of Devonian Fossils occurring at the Falls of the Ohio.

SPECIES.	Upper Helderberg Group.	Hydraulic & Encrinal Limestones.	Hamilton Gr'p, N. Y.	Chemung Gr'p, N. Y.
Corals.				
Michelinia stylopora	.	*	*	.
Crinoidea.				
Actinocrinus eucharis	.	*	*	.
A. Kentuckensis	.	*	.	.
A. multicornis	*	.	.	.
A. pentaspina	*	.	.	.
A. Cassedayi	.	*	.	.
Megistocrinus abnormis	.	*	.	.
M. depressus	.	*	*	.
M. Knappi	*	.	.	.
M. Ontario	.	*	*	.
M. rugosus	.	*	.	.
M. spinosulus	*	.	.	.
M. plenissimus	.	*	.	.
Dolatocrinus glyptus	.	*	*	.
D. lacus	.	*	.	.
D. sculptilis	.	*	*	.
D. Marshi	*	.	.	.
Cyathocrinus læviculus	.	*	.	.
C. sculptus	.	*	.	.
C. Wortheni	.	*	.	.
C. valens	.	*	.	.
Rhodocrinus Halli	.	*	.	.
Potereocrinus cylindricus	*	.	.	.
P. simplex	*	.	.	.

LIST OF DEVONIAN FOSSILS, ETC. (Continued).

SPECIES.	Upper Helderberg Group.	Hydraulic & Encrinal Limestones.	Hamilton Gr'p, N. Y.	Chemung Gr'p, N. Y.
CRINOIDEA (Continued).				
Platycrinus Leai	.	*	.	.
Codaster alternatus, representing C. pyramidatus	*	.	.	.
Nucleocrinus angularis, representing N. Lucina	.	*	.	.
N. Verneuili	*	.	.	.
N. elegans	.	?	*	.
Eleutherocrinus Cassedayi, representing E. Whitfieldi	.	*	*	.
Ancyrocrinus spinosus	*	.	.	.
A. bulbosus	.	*	*	.
BRACHIOPODA.				
Discina grandis	.	*	*	.
Orthis Vanuxemi, or its equivalent	.	*	*	.
O. Livia	*		.	.
Strophodonta inequistriata	*	*	*	.
S. demissa	*	*	*	*
S. hemispherica	*	.	.	.
S. perplana	*	*	*	*
Strophomena rhomboidalis	*	.	.	.
Chonetes Yandellana, representing C. scitula	.	*	?	.
C. acutiradiata	*	.	.	.
Productella subaculeata, var. cataracta	.	*	.	.
Spirifera euruteines	.	*	.	.
S. fimbriata	*	*	*	.
S. medialis	.	*	*	.
S. Oweni, representing S. granulifera	.	*	.	.
S. varicosa	.	*	*	.
S. segmenta	.	*	*	.
S. acuminata	*	.	.	.
S. arctisegmenta	*	.	.	.
S. duodenaria	*	.	.	.
S. gregaria	*	.	.	.
S. raricosta	*	.	.	.
Ambocœlia umbonata	.	*	*	.
Cyrtina Hamiltonensis	*	*	*	*
C. crassa	*	.	.	.
Trematospira hirsuta	.	*	*	.
Nucleospira concinna	*	*	*	.
Athyris spiriferoides	*	*	*	.
A. vittata, representing A. Cora	.	*	.	.
Meristella nasuta	*	.	.	.
M. (Pentagonia) unisulcata	*	.	.	.
Atrypa reticularis, and varieties	*	*	*	*
A. aspera	.	*	*	.
Rhynchonella Tethys	*	.	.	.
R. Sappho	.	*	*	.
Pentamerella arata	*	.	.	.
P. papilionensis	.	*	*	.
Terebratula harmonia	.	*	*	.

LIST OF DEVONIAN FOSSILS, ETC. (Continued.)

SPECIES.	Upper Helderberg Group.	Hydraulic & Encrinal Limestones.	Hamilton Gr'p, N. Y.	Chemung Gr'p, N. Y.
BRACHIOPODA (Continued).				
Cryptonella rectirostra	.	*	*	.
C. lens	.	*	*	.
Tropidoleptus carinatus	.	*	*	.
LAMELLIBRANCHIATA.				
Pterinea flabellum	.	*	*	*
Limoptera cancellata, v. occidens	.	*	*	.
Aviculopecten pecteniformis	*	*	*	.
A. princeps	.	*	*	.
A. parilis	.	*	*	.
A. crassicostata, representing a Hamilton form	.	*	.	.
Nuculites triqueter	.	*	*	.
Nucula Neda=N. bellastriata var	.	*	.	.
N. Niotica	.	*	.	.
Modiomorpha concentrica	.	*	*	.
Cypricardinia inflata	.	*	*	.
C.? cylindrica	.	*	.	.
Yoldia? valvulus	.	*	.	.
Tellinomya subnasuta	.	*	.	.
Ptychodesma Knappianum	.	*	.	.
Grammysia secunda, v. gibbosa	.	*	*	.
Lucina (Paracyclas) elliptica	*	.	.	.
L. P. lirata	.	*	*	.
Cardiopsis crassicosta, representing P. robusta	*	*	.	.
Conocardium trigonale	*	.	.	.
GASTEROPODA.				
Playtyceras conicum	*	*	*	.
P. cristatum, n. sp. near P. carinatum	.	*	.	.
P. bucculentum	.	*	*	.
P. rictum	*	*	*	.
P. dumosum	*	.	.	.
P. dumosum, v. rarispinum	*	.	.	.
P. fornicatum	*	*	*	.
P. symmetricum	*	*	*	.
Tlatyostoma lineatum	*	*	*	*
Trochonema emaceratum	.	*	.	.
T. Yandellanum	.	*	.	.
P. rectilatera	.	*	.	.
Pleurotomaria sulcomarginata	.	*	*	.
P. Estella, representing P. Itys	.	*	.	.
P. Lucina	*	*	*	.
Pleurotomaria imitator	*	.	.	.
Loxonema hydraulicum	.	*	.	.
L. rectistriatum	.	*	.	.
L. læviusculum	.	*	.	.
Naticopsis lævis	*	.	.	.
Turbo Shumardii	*	.	.	.
Bellerophon Lyra	.	*	*	.
B. Leda	.	*	*	.

LIST OF DEVONIAN FOSSILS, ETC. (Continued.)

SPECIES.	Upper Helderberg Group.	Hydraulic & Encrinal Limestones.	Hamilton Gr'p, N. Y.	Chemung Gr'p, N. Y.
GASTEROPODA (Continued).				
Bellerophon patulus	.	*	*	.
PTEROPODA.				
Coleolus tenuicinctum[1]	.	*	*	.
CEPHALOPODA.				
Gomphoceras turbiniforme	.	*	.	.
Goniattes discoideus, v. Ohiensis	.	*	*	.
CRUSTACEA.				
Phacops bufo, v. rana	.	*	*	.
Dalmanites myrmecophorus	*	.	.	.
D. anchiops	*	.	.	.
D. Ægeria	*	.	.	.
D. Helena	*	.	.	.
D. selenurus	*	.	.	.
D. Calypso	*	.	.	.
D. Pleione, representing D. Boothi	.	*	.	.
Proetus crassimarginatus	*	.	.	.
P. canaliculatus	*	.	.	.

The above list of fossils is far from being complete; but at the present time we have not the means of perfecting it. When once the facts are recognized, and the position of these beds acknowledged, they will be studied as a distinct formation, and the fossils separated from those of the beds below, with which they have hitherto been confounded.

[1] This fossil, which is apparently identical with the New York species, is quite common in the same bed with *Chonetes Yandellana,* at the Falls of the Ohio. Messrs. Yandell and Shumard in speaking of the "siliceous crust," above the waterlime, say: "In this crust we find a small Orthoceratite, two and sometimes three inches in length, with very thin septa. We have not been able to detect the position of the syphon. It is always siliceous." This "small Orthoceratite" is unquestionably the Coleolus, cited above; and the slender cinctæ were very naturally regarded as the septa.

It should be remembered that the facts above stated, and the fossils enumerated, have been derived from a single locality — the Falls of the Ohio river. Elsewhere, in Kentucky and Indiana, the same conditions exist and the same species of fossils are known. In the state of Ohio similar conditions may be inferred, from the fact that certain species of known Hamilton fossils are published in the Ohio Geological Reports as from the Corniferous group.

In the state of Wisconsin, the magnesian limestones of the Humboldt river, near Milwaukee, are charged with characteristic Hamilton fossils, and doubtless represent the hydraulic limestone and superincumbent beds at the Falls of the Ohio. I shall, at some future time, give a list of species which I have recognized in that locality during a former geological survey of the state. In the states of Illinois and Iowa, the Hamilton group is everywhere partially or entirely represented by a limestone, and the term " Hamilton limestone " has been used in the geological reports of the former state. In those portions of the country where the Upper Helderberg limestone is not known as a member of the series, there seems less difficulty in recognizing the age and character of the Hamilton limestones. It is in those localities where the Upper Helderberg limestone is well developed, and where the superincumbent beds are conformable, that they are likely to be regarded as a component part of the formation, and their fossils grouped together in accordance with this view.

The number of species of the hydraulic and encrinital limestones which are common to these beds and the Hamilton group of New York, as shown in the list above presented, certainly offers very strong evidence in support of the view which I am compelled to take, that they are the equivalent of the Hamilton group of New York; and not only the equivalent, but the actual extension of the group in a southwestern direction, in the form of calcareous beds, beyond the limits of the littoral and off-shore, sediments, which characterize the formation for three hundred miles of its outcrop within the state of New York.

The erroneous determination of the age of these beds having permeated all the literature of the science for years past,[1] it will be necessary to make the correction wherever in the volumes of the New York Palæontology, and other reports and papers upon geology and palæontology, the fossils contained in these Hamilton beds have been referred to the Upper Helderberg group.

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[1] A single exception has come under my observation. Messrs. Lyon and Casseday, in a paper describing new species of Crinoidea (*American Journal of Science*, vol. 28, p. 244), under "*Geological position and locality*," of *Megistocrinus rugosus*, use the following language: "It is found in the Devonian rocks of the age of the Hamilton group, associated with *Orthis suborbicularis*, *Atrypa reticularis*, *A. aspera*, *Euomphalus cyclostomus?* etc. This is about the same horizon in which Hall found his *Megistocrinus latus*."

This is the only reference of any of these fossils to the Hamilton group which I have been able to find among the writings of Lyon and Casseday, or of Major Lyon.

REMARKS ON THE DUDLEY OBSERVATORY OBSERVATIONS OF THE TRANSIT OF MERCURY, MAY 6, 1878.

By Lewis Boss,

Director of the Dudley Observatory.

[Read before the Albany Institute May 28, 1878.]

The transit of Mercury which occurred on the sixth of this month has attracted a great deal of attention in the United States. Its accurate observation was felt to be important not only in its relation to the situation of Mercury in its orbit and the physical condition of the planet, but also, as affording an opportunity for many inexperienced observers to put themselves in training for the important transit of Venus which will be visible from this part of the world in 1882. In view of this general interest I venture to present to the Institute a more extended notice of the Dudley Observatory observations than I should otherwise have deemed proper.

In these observations, the thirteen inch equatorial was used at the Observatory; and in order to increase the chances of success, a party was sent from the Observatory to the coast survey station "Helderberg," about fifteen miles west from Albany. As will appear from the appended report of Assistant Landreth, who was in charge, the observations of the party were successful. At the Observatory, my own observations of contact were much affected by the bad state of the air in the morning, and wholly prevented by clouds in the afternoon.

For some days preceding the transit, the weather had been generally stormy, and on the day before there was a copious cold rain nearly all day, with a sudden clearing in the evening. The morning of the sixth was warm and nearly cloudless. The rays of the blazing sun, acting on the soil so recently saturated with plentiful rains, constantly evaporated streams of invisible vapor, which apparently condensed, at about one thousand feet above the surface of the earth, into a fog, which was invisible against the strongly illuminated background of the sky. This fog was so dense that the Helderberg party at an altitude of 1600 feet above the Observatory, were unable to discern objects beneath it, and hence inferred the failure of the contact observations with the thirteen inch equatorial.

To prepare the instrument for observation, the aperture was reduced to eight inches. A solar diagonal eye piece by A. Clark & Sons, with plane glass reflector was employed. The plane glass surfaces are inclined to to each other so that the reflection from the front surface alone is used. The magnifying power used in the contact observations was 275 diameters. The recorded times were taken from the Dent sidereal clock, whose correction and rate were determined by 12 transits of stars extending from α Can. Ven. (May 5. 4,) to η Urs. Maj. (May 6. 4). The transit was reversed for collimation on each evening. The resulting correction to Dent is:

$$-44.^s7 - {}^s.52\ (T - 5.9)$$

where T denotes the date in May expressed in fractional parts of a day.

On the night preceding the transit I had carefully adjusted the instrumental focus on bright stars, anticipating the possibility of bad definition on the following day. This proved to be a wise precaution, for the first glimpse of the sun obtained through the equatorial on the morning of the sixth showed the image of the sun's limb to be in a state of extraordinary agitation, and that the projected observation of external contact would be next to impossible.

During the morning hours heliotrope signals were observed in conjunction with the Helderberg party, for the purpose of furnishing the Dudley Observatory local time to the latter. These signals were supplemented by powder flashes on the evenings of the 5th and 6th. The necessary details will be found in Mr. Landreth's report appended.

Although I was on the lookout for the advancing segment of Mercury for fully two minutes before the predicted time of first contact, my attention was so distracted by the constantly increasing and deep rippling waves on the sun's limb, that I saw nothing of the planet until $22^h\ 18^m\ 14^s$ D. O. M. T.; and at that time the segment was so large that the observation was valueless.

The record of the first internal contact stands thus:

Dent times.	D. O. M. T.	Remarks.
$1^h\ 18^m\ 50^s$	22 20 43.0	First suspected.
18 53	46.0	Signal given.
18 56	49.0	Internal contact.
19 05	58.0	Contact certainly past.

The time first recorded marks the earliest instant at which I entertained suspicions that internal contact had taken place. Across the dark gap in the sun's limb formed by the disc of Mercury, filaments of light due to atmospheric tremors were continually darting and interlacing. I had determined to watch for the instant when a part of these filaments of light coalesced into one unbroken thread, and to regard that as the moment of internal contact. Accordingly, at the second of the recorded times I gave the signal to an assistant, when I had a momentary impression that the light thread had formed; keeping up the count of seconds, however, it was not until the third time above recorded that I felt confident that internal contact was effected. Nine seconds later, there was no longer the slightest doubt.

I had (previously to the transit) formed the opinion, from a careful consideration of the experience of others, supplemented by theoretical considerations, that it is important that the observer of an internal contact should ignore as much as possible the phenomenon as a whole, and devote his attention as exclusively as possible to the expected point of juncture of the advancing cusps. In addition to this he should be provided with a high magnifying power, since the matter of distinct definition is, in this case, not highly important. In fact it appears to me that the requirements of this case bear a close analogy to those involved in the detection of a faint and moderately close companion of a bright star.

The definition could not well have been worse than in the observation just recorded. Under the circumstances and viewing the phenomenon as a whole with a low power, I am convinced that the apparent uncertainty would have been at least 20 or 30 seconds; as it was I felt that the phenomenon as shown in my telescope under all the disadvantages was not uncertain more than 5 seconds. I had fully intended to use a power of 500, under good atmospheric conditions.

Principally through the kindness of the respective observers I am able to present a comparison of the Dudley Observatory times of contact with a few others. Using the data of the American Ephemeris, except that the semidiameter of the sun is assumed to be (with the *Berlin Yahrbuch*), 16′ 01″.2, I find after a tolerably rigorous computation the predicted Washington times of contact for a given place in longitude, λ, west from Washington and in north geocentric latitude φ' to be:

I. $22^h\ 05^m\ 34.5^s - [1.8715]\,\rho\,\mathrm{Sin}\,\varphi' - [1.9156]\,\rho\,\mathrm{Cos}\,\varphi'\,\mathrm{Cos}\,(226°\ 10' - \lambda)$
II. $22\ \ 08\ \ 42.0 - [1.8738]\,\rho\,\mathrm{Sin}\,\varphi' - [1.9147]\,\rho\,\mathrm{Cos}\,\varphi'\,\mathrm{Cos}\,(226°\ 40' - \lambda)$
III. $5\ \ 37\ \ 31.1 - [1.2500]\,\rho\,\mathrm{Sin}\,\varphi' + [2.0415]\,\rho\,\mathrm{Cos}\,\varphi'\,\mathrm{Cos}\,(172°\ 49' - \lambda)$
IV. $5\ \ 40\ \ 38.6 - [1.2595]\,\rho\,\mathrm{Sin}\,\varphi' + [2.0407]\,\rho\,\mathrm{Cos}\,\varphi'\,\mathrm{Cos}\,(173°\ 32' - \lambda)$

The numbers in brackets are logarithims of numbers expressing seconds of time, and ρ is the radius vector of the earth for the given place whose geocentric latitude is φ'. For convenience of reference we have the following table of observers and places.*

Observatory.	Observer.	Longitude.
Dudley Observatory,	Boss,	— 13^m 13^s
Helderberg Station,	Landreth,	— 12 10
" "	Wilson,	— 12 10
Alleghany, Penn.,	Langley,	+ 11 51
Hanover, N. H.,	Paul,	— 19 04
So. Bethlehem, Penn.,	Doolittle,	— 6 40
Cincinnati, Ohio,	Stone,	+ 29 29
" "	Howe,	+ 29 29
Ann Arbor, Mich.,	Watson,	+ 26 43
Glasgow, Mo.,	Pritchett,	+ 63 13
Hastings on Hudson,	Holden,	— 12 ?
" " "	Draper,	" "
" " "	Barker,	" "
New Haven, Conn.,	Skinner,	— 16 30
" " "	Beebe,	— 16 30
" " "	Hazen,	— 16 30
Washington, D. C.,	Newcomb,	00 00
Annapolis, Md.,	Naval Acad.,	— 2 15
Antwerp, Brussels,	de Böe,	— 325 51
" "	von Ertbon,	— 325 51
Wimbledon, Eng.,	Penrose,	— 307 17

* This table (and the subsequent comparison of observed contacts) includes some materials not available to me at the time of reading this paper, and I have accordingly taken the liberty of revising this part of my remarks by the insertion of the additional data.

With the help of the equations previously given, each observed time of contact is reduced to the centre of the earth, and in the separate tables of each contact, arranged in the order of time. The first column gives the name of the observer; the second column the reduction to the center of the earth; the third the reduced Washington time of contact. The observed local times are not given, but they may be deduced by subtracting the respective longitudes from the sums of the corresponding numbers in the second and third columns of the tables of contacts.* The fourth column of each table gives the correction to prediction, as computed from Leverrier's old theory of Mercury and the other elements of the American Ephemeris in the manner already indicated. The fifth column gives the correction to the time predicted from Leverrier's later tables with Leverrier's diameter of the sun. This part of the comparison is derived from "Nature" of June 6, 1878. Though whole seconds only are given here, in the computations the tenths of seconds were always preserved.

In the first contact the planet was not identified by many observers until the segment was seen to have obtained a very appreciable size. Such observations are not included in the list.

I. Ingress. External Contact.

Observers.	Reduction.	Wn. time, red. to Center of Earth.	Correction to Am. Eph.	Brit. N. A.
Langley,	— 2s	22h 04m 43s	— 51s	— 10s
Doolittle,	— 6	47	— 47	— 6
Nav. Acad.,	— 3	47	— 47	— 6
Landreth,	— 11	48	— 47	— 6

* Several of the contact times as communicated to me, were given in Washington mean time.

Observers.	Reduction.	Wn. time red. to Center of Earth.	Correction to Am. Eph.	Brit. N. A.
Watson,	— 3	22h 04m 49	— 45	— 4
Skinner,	— 9	52	— 42	— 1
Pritchett,	+ 8	[59]	[— 36]	[+ 6]

II. Ingress. Internal Contact.

Observers.	Reduction.	Wn. time, red. to Center of Earth.	Correction to Am. Eph.	Brit. N. A.
Landreth,	— 11s	22h 07m 28s	— 74s	— 32s
Howe,	+ 2	29	— 73	— 31
de Böe,	— 90	33	— 69	— 28
Stone,	+ 2	33	— 69	— 27
von Ertbon,	— 90	34	— 68	— 27
Wilson,	— 11	40	— 62	— 20
Langley,	— 3	41	— 61	— 19
Skinner,	— 10	42	— 60	— 18
Beebe,	— 10	42	— 60	— 18
Watson,	— 4	44	— 58	— 16
Newcomb,	— 3	46	— 56	— 14
Paul,	— 14	46	— 56	— 14
Boss,	— 11	48	— 54	— 13
Nav. Acad.,	— 3	48	— 54	— 12
Pritchett,	+ 8	[49]	[— 53]	[— 12]
Penrose,	— 86	50	— 52	— 10
Doolittle,	— 7	[70]	[— 31]	[+ 10]

III. Egress. Internal Contact.

Observer.	Reduction.	Wn. time red. to center of Earth.	Correction to Am. Eph.	Brit. N. A.
Paul,	— 91s	5h 35m 19s	— 132s	— 26
Draper,	— 94	21	— 130	— 24
Skinner,	— 94	22	— 129	— 23
Hazen,	— 94	23	— 128	— 22
Wilson,	— 93	24	— 127	— 21
Newcomb,	— 96	26	— 125	— 19

Observer.	Reduction.	Wn. time red. to Center of Earth.	Correction to Am. Eph.	Brit. N. A.
Doolittle,	— 95	$5^h\ 35^m\ 26$	— 125	— 19
Barker,	— 94	27	— 124	— 18
Holden,	— 94	28	— 123	— 17
Nav. Acad.,	— 96	36	— 115	— 09
Pritchett,	— 90	[40]	[— 111]	[— 05]
Landreth,	— 93	41	— 110	— 04

IV. Egress. External Contact.

Observer.	Reduction.	Wn. time red. to center of Earth.	Correction to Am. Eph.	Brit. N. A.
Nav. Acad.,	— 96^s	$5^h\ 38^m\ 12^s$	— 147^s	— 41
Wilson,	— 93	12	— 147	— 41
Landreth,	— 93	13	— 146	— 40
Doolittle,	— 95	14	— 144	— 38
Paul,	— 92	15	— 143	— 37
Draper,	— 95	16	— 143	— 37
Newcomb,	— 96	16	— 143	— 37
Hazen,	— 94	26	— 133	— 27
Holden,	— 95	26	— 133	— 27
Skinner,	— 95	28	— 130	— 24
Pritchett,	— 90	[35]	[— 123]	[— 17]
Beebe,	— 94	[37]	[— 122]	[— 16]

In reference to these observations there are a few circumstances which call for special remark. I have omitted Mr. Wilson's observation of Contact I. The small telescope used by him was so shaken by the wind as to make the early recognition of the planet practically impossible. Judged by the testimony of other observations, Mr. Landreth's times of internal contacts appear to be affected by a constant source of error in the direction which might have been anticipated from his remark that the outline of the planet appeared as a "protuberance" beyond the sun's limb in Contact II. The observer is exceptionally keen sighted, and the air at his station was undoubtedly very clear and steady. Is it not possible that Mr. Landreth may have seen the planet projected against the solar "sierra," or some part of the solar envelope, not ordinarily visible in telescopic observation? Of the reality of the phenomenon as it appeared to him I entertain no doubt. Professor Doolittle remarks that his Contact II appeared to be late at the time of observation. Mr. Pritchett's observations may be affected by an error in his assumed value of the longitude of his observatory, which depends, at present, on observed occultations of stars by the moon. Moreover, I have used for internal contacts another phase than that indicated by him, which latter, from all I can gather, is that of "geometrical" contact.

During the transit and through intervals in the clouds, I obtained thirteen tolerably good micrometrical measures of the diameter of Mercury. Uncorrected for irradiation and possible expansion of the micrometer screw, the result is: $11''.30 \pm ''.14$. The observations were obtained with great difficulty, but are believed to be as reliable as could be expected from the smallness of the number of measures. Taking this diameter as the "Transit" diameter we have as the true interval between Contacts I and II, as well as between III and IV:

$$187.^s5 \times \tfrac{11.3}{12.0} = 176.^s6.$$

If now, we suppose that for the average of observers external contact is retarded at ingress and accelerated at egress six seconds, we have as the true interval $170.^s6$. This seems to correspond well with the observations. Giving equal weight to all observations of a given contact, which are not included in brackets, we have:

Contact.	Number of Observations.	Observed Washington time reduced to the Centre of the Earth.	Correction to Am. Eph.	Correction to Brit. N. A.
I.	6	22^h $04^m 47.^s8$	— $45.^s7$	— 4^s
II.	15	22 07 40.2	— 61.8	— 20
III.	11	5 35 26.7	— 124.4	— 18
IV.	10	5 38 17.9	— 141.7	— 35
Means.			— 93.4	— 19.5

It will thus be seen that Mercury was in advance of his position relatively to the sun as predicted from the American Ephemeris and as seen from the earth, $6''.0$, or one-half his own diameter ; and $1''.3$ in advance of the relative position, as predicted from the English almanac. What proportional part of these discrepancies should be assigned to the erroneously predicted places respectively of the sun and planet, it is not our province to examine. It is sufficient to remark that Leverrier's later tables of Mercury containing the effect of a term due to the supposed attraction of a body interior to the orbit of that planet, give a satisfactory representation of the facts. It will also be noticed that the observed interval between I and II is $172.^s4$ and between III and IV, $171.^s2$, in each case agreeing closely with the quantity $170.^s6$ previously deduced,— an agreement calculated to inspire confidence in the correctness of the mean results, for the several contacts within the amounts which may be anticipated from their probable errors, which are approximately, $\pm$ $1.^s3$.

During the afternoon, I enjoyed several brief but measurably fine opportunities for scrutinizing the disc of Mercury. I noticed no variation in the color of the disc. There did not appear to be the slightest trace of spot or halo, though the planet was examined with three different eye-pieces of magnifying powers 200, 275 and 500 respectively. With the lowest power, direct vision was employed. There were occasionally transient mottlings of the disc; but these I attribute to persistence of vision, since they did not appear to my eye except when the telescope was vibrated by occasional gusts of wind. Several visitors who were with me during the afternoon viewed the planet as shown in the telescope with the same result.

In conclusion I present a summary of the Dudley Observatory observations of contact in Albany local mean-time.

CONTACTS.

Observer.	I.	II.	III.	IV.
Boss,	....	$22^h\ 20^m\ 49.^s0$	....	....
Landreth,	$22^h\ 17^m\ 50.^s0$	29.5	$5^h\ 47^m\ 20.^s7$	$5^h\ 49^m\ 53.^s2$
Wilson,	[18 17.5]	42.0	04.2	52.2

The details relating to the observations at the Helderberg station follow in Mr. Landreth's own words.

REPORT OF MR. O. H. LANDRETH.

DUDLEY OBSERVATORY, *May* 28, 1878.

Dear Sir:

In accordance with your request, I beg leave to submit the following report, relating to observations made by the party dispatched from the Dudley Observatory, to observe the transit of Mercury on May 5 – 6, 1878.

In considering the probability of the 6th of May being favorable for observation it was deemed advisable by you that entire dependence should not be placed on the chances of the occurrence of favorable weather at Dudley Observatory, but that a party be sent, with the necessary equipments, to some point differing in atmospheric conditions from Albany. Accordingly, after consultation with Professor Gardner and Mr. Wilson of the N. Y. State Survey, the station finally occupied was chosen, as most probably presenting the features requisite to the purpose.

The point selected was the U. S. Coast Survey Primary Station "Helderberg" on the Helderberg range, about fifteen miles west of Albany, in latitude north 42° 37′ 37″.55, longitude east of Washington 0^h 12^m $9^s.77$, as determined by the U. S. Coast Survey, the elevation of which above mean time is 1840 feet, as determined by Mr. Johnson, the meteorologist of the party, from a series of hypsometric observations extending over May 4th, 5th, and 6th.

In preparing for the transit proper, the diagram contained in the pamphlet issued by the Superintendent of the Naval Observatory was at first used for examination, but the relation of the sizes of the sun and planet was there so much exaggerated, that it was thought advisable, in order the more nearly to produce the exact representation of features, to use a diagram giving the true relative dimensions as well as the apparent angular magnitudes of the two bodies. Accordingly such a diagram designed to be viewed at a distance of 4500 feet, was constructed by Mr. Wilson, having the four following phases:

1. Indentation of Mercury on sun's limb,	0″.25
2. " " " " " "	0″.50
3. True internal contact	
4. Mercury wholly within sun's disc, least distance of adjacent limbs,	0″.25

This diagram, arranged for ingress but equally suitable for egress, was carefully studied with the telescopes to be used on the expedition; the line of sight passing for the last few hundred feet within four or five feet of the ground, thus introducing artificially the unsteadiness usually accompanying examinations of the sun's disc.

An examination of this kind, I consider of considerable value, to furnish a scale or list of known phases, to which to refer and compare the observed phenomena; as well as to familiarize the observer with the features to be expected in the actual transit, especially if he be inexperienced in similar observations.

The Helderberg party consisted of Mr. O. S. Wilson of the N. Y. State Survey, Professor G. D. Olds of the Albany Academy, Mr. W. E. Johnson of the Physical Department of Union College, and myself. Also Mr. John O'Hara and Mr. Cookingham stationed at the State Survey Station "Ferris," to flash time signals.

The instruments taken were the Clark & Son's equatorially-mounted Comet-Seeker of the Observatory—aperture 3.9 inches, focal length 42 inches, provided with position micrometer, eye pieces, shades, etc.

The Dolland Alt.—Azimuth mounted telescope of the Albany Academy—aperture 2.7 in., focal length 44 in.

A Dent mean-solar box chronometer, a Troughton 10 inch Sextant, a mercurial barometer, a hypsometer and wet and dry bulb hygrometer from Union College.

A mean-solar pocket chronometer from Mr. C. Fasoldt.

Three heliotropes, one to "Helderberg," and two to "Ferris." A prismatic compass, an aneroid barometer, a field glass, an observing tent and a fly tent from the State Survey Office, also equatorial stand, lamps, blankets, tools, etc.

All necessary arrangements having been completed, the party with its outfit left Albany on the morning of May 4th. The station was reached at 6 P.M., of the same day and the tents were erected and instruments placed in approximate position at once. During the evening a heavy rain set in which continuing for twenty-four hours, necessarily prevented all operations during that interval except the meteorological observations by Mr. Johnson.

It had been my intention to observe during transit, differences of the sun's and planet's right-ascension and declination near the time when the latter quantity passed through zero, by an application of the method of inclined wires; and for this purpose, which required precise knowledge of its astronomical position, the instrument was mounted on its own heavily framed stand, which rested on the foundation constructed for the coast survey instrument. The night of May 5th being clear, permitting work in general to be resumed, the telescope was equatorially located and the final coördinates of the pole of the instrument as referred to the celestial pole determined by observations of the declination of fundamental stars on the meridian and six-hour circle. The details and results of this work are omitted, since the observations which would have depended on it, were prevented by clouds.

The Dolland telescope was mounted at ingress on a temporarily constructed stand placed about twelve feet east of the observing tent. The lack of perfect solidity in the mounting, rendered troublesome by the wind which was blowing briskly at the time of ingress, induced Mr. Wilson to discard the stand at egress and to place the instrument on the ground, observing in a reclining position, which alteration gave more satisfactory results.

To insure certainty in obtaining the time within the degree of precision required, three independent methods for its determination were adopted:

[*A*.] A system of flash signals was arranged to be given at preconcerted times by Messrs. O'Hara and Cookingham at the State Survey Station "Ferris," which is visible from both Dudley Observatory and Helderberg; the observed times of the flashes to be referred simultaneously to the standard Dent clock of the Observatory and to the chronometers at Helderberg.

The programme was as follows:

PRECONCERTED PROGRAMME OF FLASH SIGNALS.

Series.	Commencing with		Intervals between flashes.
1	May 5th, $8^h\ 30^m$	4 Powder flashes,	5^m
2	" 5th, $21^h\ 00$	20 Heliotrope flashes,	1^m
3	" 6th, $8^h\ 30$	4 Powder flashes,	5^m

[*B*.] Sextant solar and star observations to be used in conjunction with or in case of failure of [*A*].

[*C*.] The chronometers of the expedition, transported with great care, but to be relied on only in case of failure of both [*A*] and [*B*].

The difficulty experienced in obtaining a sufficient number of good sextant observations owing to the interference of clouds, together with the fact that the present imperfect working condition of the instrument necessitated the use of a small weight for the results, have led me to depend alone on the flash signals for the adopted time, though the results of the sextant work are here given:

SEXTANT OBSERVATIONS, ALTITUDES OF SUN.

Date.	No. of contacts.	Chronometer Correction to Held, M. T.		Observer.
May $5^d.85$, 1st Series,	10	$-1^m\ 2^s.26$		Wilson
" 5 .86, 2d Series	10	$-1\ 1\ .60$	$-1^m\ 1.^s93$	"
" 6. 19	2	....	$-1\ 11\ .38$	"

Mean correction to Helderberg M. T., -1^m 6.65

Longitude correction to Dudley Observatory $+1^m$ 3.10

May $6.^d03$ Chronometer correction to D. O. M. T., — $0^m\ 3.^s55$

Flash Signals.

May 5 .36	2	Powder flashes,	—4s.2
" 5 .89	8	Heliotrope "	—4 .9
" 6 .36	4	Powder "	—6 .2

From the above result are interpolated the chronometer corrections for the times of transit.

At ingress May 5 .93 Chron. corrn to D. O. M. T.—5s.0
" egress " 6 .24 " " " " " " —5s.8

Observation of the Transit.

Observer.	Telescope.	Focal length.	Aperture.	Power.	Shade.
Wilson,	Dolland,	44in	2.7in	90	Green
Landreth,	Clark,	42	2. 0	110	Neutral-violet.

Observed Times of Contact.

I.

Observer.	Phase.	Chronometer Times.	D. O. Mean Times.
Wilson,	(*a*)	May 5d 22h 18m 22.s5	22h 18m 17.s5
Wilson,	(*b*)	" " " 18 25.0	" 18 20.0
Landreth,	(*c*)	" " " 17 55.0	" 17 50.0

II.

Wilson,	(*d*)	5d 22h 20m 47.s0	22h 20m 42.s0
Landreth,	(*e*)	" 20 34.5	" 20 29.5

III.

Wilson,	(*f*)	6d 5h 47m 10.s0	5h 47m 4.s2
Landreth,	(*g*)	" " 47 26.5	" 47 20.7

IV.

Wilson,	(*h*)	6d 5h 49m 58.s0	5h 49m 52.s2
"	(*i*)	" " 50 05.0	" 49 59.2
Landreth,	(*j*)	" " 49 54.0	" 49 48.2
	(*k*)	" " 49 59.0	" 49 53.2

DESCRIPTION OF PHASES.

a. Indentation suspected.

b. Indentation sure.

c. Indentation between phases (1) and (2) D. O. Diagram.

d. Instrument very unsteady.

e. Light closes around planet. No "*black drop.*"

f. Uncertain. Large "*black drop.*"

g. Sudden breaking of thread of light. No "*black drop.*"

h. Last indentation surely seen. Sun's limb serrated.

i. Last indention suspected.

j. Indentation size of phase (2) on D. O. Diagram.

k. Indentation last surely seen.

The two observers, though separated by only about twelve feet were entirely independent and unbiased; they being mutually invisible without change of position.

The instrumental times recorded are those given by the Union College Dent mean-solar chronometer beating half seconds, which was placed midway between the two observers, to both of whom the sound of the beat was plainly audible, and for whom the count was continually verified by Mr. Johnson by ticking off every tenth second.

Professor Olds assisted Mr. Wilson by identifying the decades of seconds and the minutes, and recording his observations; while I kept my own record and count, verifying the latter both before and after each contact.

The unsteadiness of the Dolland glass at ingress caused by wind, in its unstable and exposed position, together with the difficulty of changing an alt-azimuth motion into a uniform equatorial one, rendered the observation of the first contact somewhat unsatisfactory to Mr. Wilson, but with the Clark instrument, free from these disturbing causes, the planet appeared in contact at the center of the segment of about 20° of the sun's limb cut off for its reception by an oblique micrometer wire, and my vision was directed to that point at the instant of appearance, the sun's limb appearing beautifully steady and sharply defined.

At instant just preceding internal geometrical tangency at Contact II, there darted out from each cusp a thread of light and closed instantaneously about the planet, forming for the instant a slight protubrance on the sun's limb. The instant of the occurrence of this phenomenon is that designated as phase (*e*).

The same phenomenon, though in a reverse order, appeared at egress, except that concerning the momentary existence of the prominence I could not be certain, owing to the greater unsteadiness of the sun's limb; but in both instances nothing could be imagined more sudden than the flashing together and the dividing of the thread of light between the planet's and sun's limb; possibly appearing more remarkable to me as I was prepared not to be surprised at seeing a "*black-drop.*"

Concerning the physical features sought during transit, the almost uninterrupted cloudiness of the sky which prevailed from II to III, prevented any extended examination of the planet, but at 23^{h} 00^{m} the existence of a small illy-defined light spot near the center of Mercury's disc was suspected, and the suspicion was afterwards repeatedly verified by both Mr. Wilson and myself. It appeared in form slightly elongated or more properly pear-shaped; in position a little to the east and, as estimated, north of the center of the disc.

I am convinced that if this appearance must be decided to be an optical illusion, as seems most probable, it must still partake of the character of something more than an impression; and, moreover, it can hardly be subjective, for it retained an unchanged position on the disc whatever the position of the eye while examining it. It also appeared more clearly defined, the better the definition, and smaller and more sharply outlined, the more intense the vision. On the other hand, it did not appear to be changed in position by the planet's rotation as seen at last view obtained at about $3^h\ 30^m$.

In searching for appearances of a dark or luminous ring surrounding the planet, every combination of neutral-violet, red, green and purple glass was used, with the only results that with the combination red and purple whose resultant color was red tending to magenta, there appeared, at instants of the best definition, a very faint violet halo extending outward approximately one-fourth the planet's diameter; but beyond the fact of its being several times seen, nothing could be determined concerning it: the opportunities for viewing the planet through intervals in the clouds being short and widely separated.

The atmospheric conditions at Helderberg, although unfavorable and threatening at other times, were, during the occurrence of the contacts, almost unexceptionable, especially so at I and II when the air was peculiarly clear and transparent, and, in the immediate proximity to the sun, the sky assumed that intense blackness which could only exist in the absence of vapors and suspended matter in the atmosphere. Indeed the station seemed to partake of the features characteristic of a point of much higher elevation than the hypsometric observations and the coast survey geodetic results unite in giving it. The morning of the 5th, after the heavy rain of the day previous, opened clear with heavy banks of cumuli low in the northern and western horizon and the wind brisk from the north-west.

In directing the attention to the conditions of the atmosphere near Albany, the whole visible valley of the Hudson could be seen filled with heavy mists and vapors, which, increasing in density until about $23^h\ 00^m$, seemed then to move up the ranges to the east.

At Helderberg almost immediately after II, the sky became overcast with clouds, and with the exception of an occasional interruption, continued obscured until nearly the time for egress. Indeed so unpromising had the prospect become, that as the time for egress approached, all hopes of the possibility of observing it had been abandoned, although every preparation was made and the observers were in as complete readiness as though nothing threatened the observation. Most fortunate was it, for at five minutes before predicted time of III, a small but rapidly increasing rupture in the clouds appeared, which soon permitted the sun to be seen, and gave just convenient time for setting the telescopes before internal contact. The conditions for observing at egress, though inferior to those at ingress, were still moderately good. And though the images were much less steady than in the morning, the sharpness of definition was still noticeable. And on the whole, the anticipations of the meteorological conditions entertained in the selection of the station, were fully realized.

After the close of the transit nothing remained but the packing of the equipment and preparation for the return, which was deferred until the following morning. The party and outfit reached Albany safely on May 7th, somewhat fatigued, but thankful for the safe conclusion of the trip.

In conclusion, I desire to express my acknowledgments for special favors to Prof. J. T. Gardner, director of the N. Y. State Survey, in placing at the disposal of the expedition so large a part of its equipment: also to the Faculty of the Physical Department of Union College, in granting so freely the use of scientific apparatus: and to Principal M. E. Gates, of the Albany Academy, for the use of the Dolland telescope. My thanks are due in like manner to the members of the party for their hearty coöperation in attaining the objects of the expedition.

I am Sir,

Yours, very respectfully,

OLIN H. LANDRETH,

Asst. Ast. Dudley Observatory.

Prof. Lewis Boss,

Director of Dudley Observatory.

ANNELIDA CHÆTOPODA OF THE VIRGINIAN COAST.

By H. E. Webster.

[Read before the Albany Institute, Oct. 15, 1878.]

The Annelida catalogued and described in the following pages were collected in the summer months of 1874 and 1876, by the zoölogical expeditions which, for some years past, Union College has sent out during the summer vacation. The locality was in Northampton Co., Virginia, (Eastern shore of Va.), between the main-land and the line of outside islands. Collecting on the eastern shore is in many respects unpleasant. The coast is monotonous; there is very little variety of station, unless a change from soft black mud to softer blacker mud can be called variety. At low-water a great area is exposed, but from high-water mark to the edges of the channels it is always mud; and when the dredge is let down it comes up filled with the same variety of mud; of course under such circumstances the work itself can not be pleasant. However, there was abundence of life. At low water the flats were black with *Ilyanassa obsoleta* Stimp., and two species of Gelasimus were present in numbers that defied computation; oysters and blue-crabs were everywhere; *Amphitrite ornata* was so common that in many places their extended tentacles almost touched each other; *Marphysa sanguinea* appeared at every turn of the spade or haul of the dredge; *Nereis limbata*, *Drilonereis longa*, *Cirratulus grandis*, *Enoplobranchus sanguineus* and other worms were present in the mud in great numbers; small annelids and molluscs abounded among the oysters. By far the greater part of our work was done with the spade at low-water. With the exception of the Syllidæ and some other small forms, nearly every species dredged was also found between tides. In a few places we found what our boatmen called " rocky bottoms." The rocks were a thin layer of dead shells, that had been washed into the deeper parts of the channels and remained there. These shells had been very thoroughly excavated by a species of sponge and other boring animals, and in the galleries thus formed most of the smaller species of annelids were found.

The results of the work, so far as concerns the annelids may be summarized as follows:

Number of Families, represented,	- - -	23
"	Genera, - - - - - -	49
"	Species, - - - - - -	59

The number of families would by many be regarded as too small, as I have followed Grube and Ehlers, rather than Kinberg and Malmgren in regard to family limitations; using Eunicidæ, for example, to include Marphysa, Lumbriconereis and Staurocephalus, each of which has been referred (and perhaps properly) to a distinct family. In the generic classification, on the other hand, I have usually followed what may be called the modern arrangement. Nevertheless it seems very probable that the views of Prof. Grube as to the proper limitations of the genera of setigerous annelids are correct, and will ultimately prevail. Of the genera adopted, four are new and six have not previously been reported from our coast. Twenty-seven of the species are believed to be new, besides four previously described, but new to our coast.

I am under obligations to Prof. Verrill both for advice and for the use of specimens.

My thanks are also due to Mr. J. A. Lintner of the N. Y. State Museum of Natural History, who has used his wide knowledge and experience to supplement my deficiences both in knowledge and experience, in the kindest and pleasantest manner possible.

T. R. Featherstonhaugh, M. D., of Schenectady, N. Y.,

and Mr. Thomas McKechnie of Newark, N. J., rendered valuable assistance in collecting; digging and dredging with patience and even with cheerfulness which was all the more wonderful as they were not sustained by any deep affection for worms, crabs, molluscs, etc.

Fam. POLYNOIDÆ.

LEPIDONOTUS (*Leach*) *Knbg.*

LEPIDONOTUS SQUAMATUS *Knbg.*

PL. I, FIGS. 1-5.

Aphrodita squamata LINN. Syst. Nat., ed. x, p. 655.
Polynoë squamata SAV. Syst. des Ann., p. 22.
" " AUD. & M. ED. Littoral de la France, ii, p. 80, pl. i, figs. 10–16.
" " QUATR. Hist. Nat. des Ann., i, p. 218.
" " GRUBE. Fam. der Ann., p. 36.
Aphrodita punctata. Zool. Danica, iii, p. 25 (non figs. of pl. 96).
" " O. FAB. Fauna Groenlandica, p. 311.
Lepidonote punctata ŒRSTED. Ann. Dan. Consp., p. 12, figs. 2, 5, 39, 41, 47, 48.—Grön. Ann. Dors., p. 16.
Lepidonote armadillo LEIDY. Marine Invert. Faun. N. J. & R. I., Ex. Journ. Phila. Acad., series ii, vol. iii, p. 16, pl. xi, f. 54.
Lepidonotus squamatus KNBG. Eugenies Resa; Zoölogie ii. p. 13, pl. iv, f. 15.
" " JOHNSTON. Cat. British Worms, p. 109, pl. viii, f. 1,
" " MALMGREN. Nord. Hafs-Ann., p. 56.
" " Ann. Polych., p. 130.
" " BAIRD. Linn. Proc. Zoölogy, viii, p. 182.
" " VERRILL. Invert. Animals of Vineyard Sound, etc., in Report of U. S. Commissioner of Fish & Fisheries, Part I, p. 581, pl. x, figs. 40–41.
" " MÖBIUS. Untersuchung der Ostsee, p. 112.
Polynoë dasypus QUATR. Hist. Ann., i, p. 226.

L. squamatus of the American coast seems to differ somewhat from the European form. Comparing f. 1, pl 1, with Kinberg's figure (15, pl. 4, Eug. Resa), it will be seen that in our specimens the anterior eyes are larger; the lateral prolongations of the head, from which the lateral antennæ arise, much shorter; the peduncle of the median antennæ not so much depressed, etc. I have collected this species at many points from Maine to Virginia, and after careful comparison am satisfied that fig. 1, re-represents accurately the form of the head and appendages for our specimens. Not common.

LEPIDONOTUS SQUAMATUS *var.* ANGUSTUS.

Lepidonotus angustus VERR. Invert An. Vineyard Sound, etc., p. 581.

Prof. Verrill now regards the form described by him as *L. angustus* as a variety of *L. squamatus*.

Common on shells, etc., from low water to 10 fathoms.

LEPIDONOTUS VARIABILIS *n. sp.*

PL. I, FIGS. 6–11. PL. II, FIGS. 12–14.

Body narrow, of nearly uniform width throughout; slightly convex above and below. The head (pl. I, f. 6) is convex laterally, with a well marked depression running from the base of the middle antenna, nearly to the posterior margin. Eyes, lateral, circular; the anterior pair a little back of the centre, slightly larger than the posterior pair. Middle antenna about double the length of the lateral, nearly three times as long as the head, somewhat swollen at its outer third, then tapering rapidly to a filiform termination. Lateral antennæ with a slight enlargement midway, otherwise similar to middle antenna.

Palpi, a little shorter than middle antenna, swollen at base, diminishing rapidly and uniformly.

The tentacular cirri have elongated basal articles; the inferior are about the length of the lateral antennæ; the superior a little longer. In structure they are the same as the middle antenna.

Elytra, 12 pairs, completely covering the back. First pair nearly circular, the others oval, slightly broader behind than in front (pl. I, f. 7). Posterior and outer margin coarsely fringed; an isolated patch of fringe on the inner margin, not arising from the edge, but from the surface of the elytron near the edge. Along the inner border where there is no fringe, is a series of minute papillæ. When not magnified the elytra seem to be smooth. In reality they are covered with minute, sharp, spine-like projections. The color of these little spines is usually reddish brown, though they may be any shade of brown, or even white.

The dorsal cirri are about one-half the length of the middle antenna, and have the same form. They arise from a stout basal article, much swollen along its inner half; outer half cylindrical. They project by about one-third of their own length beyond the setæ. The feet are large, in length about equal to the width of the body, somewhat compressed, diameter suddenly diminishing at outer third, truncated externally. Setæ of dorsal ramus numerous, delicate, usually covered, with a single series of rather coarse denticulations (pl. II, fig. 12). Those of the lower ramus, stout, bidentate (pl. I, figs. 9, 10); superior tooth very little curved, projecting some distance beyond the inferior. Below the apex there are a few stout denticles. Of the terminal teeth, the lower is frequently worn off (pl. II, f. 13). The setæ of the lower ramus are somewhat variable in form, as shown in the figures. Those of the first segment are not bidentate (pl. I, f. 11). The ventral cirri arise at about the inner third of the feet, from a small, rounded, basal article; they are minute, conical (pl. I, f. 8). There are two very long anal cirri, longer than the middle antenna. The dorsal cirri of the last segment turn directly backward, and reach about one-half as far as the anal cirri, thus giving the appearance of four anal cirri. Color, variable. The head may be clear white, or with dark brown specks. The antennæ and all superior cirri are white, with a black or dark brown band on the enlarged portion. The palpi are usually dark brown at base, becoming lighter externally, with white tips; or they may be white throughout. The general color of the body above is some shade of brown, but the elytra vary much in their markings. Often there is a large whitish spot, with numerous minute brown spots, or the white spot may disappear. The brown sometimes becomes nearly black. In a few specimens the black occurs in large blotches; or the space usually occupied by the white spot may be black. The body beneath the elytra is yellowish white. The anal segment is brown or black, and the two or three segments preceding the anal have transverse markings of the same color as the anal segment. Ventral surface more nearly uniform in its markings than the dorsal. General color, yellowish-white. Margins of each segment with an irregularly shaped brown spot. A central, white or yellowish-white, line, on each side of which on each segment is a brown spot. The anal cirri are usually dark colored throughout, and the external enlargement is hardly perceptible.

On pl. II, f. 14, a head is figured which will be seen to differ much from f. 6; but it is only in the head that the two forms differ. In setæ, shape of feet, form and character of elytra, etc., they agree perfectly. At least half of the specimens corresponding to fig 14 were females. I could not determine the sex of the others. Possibly this may be a sexual form, though I have been unable to find any notice of sexual variations in this group of annelids. It will be seen that the anterior margin of the first segment is prolonged on each side of the middle line into little triangular folds, which in contracted specimens encroach on the posterior margin of the head. This is also the case with *L. variabilis.*

Length 10 to 20^{mm}; diameter 2 to 4^{mm}—some of the widest specimens not being more than 15^{mm} in length, while some of the longest are not over 3^{mm} in width. Number of segments (setigerous), 25.

ANTINOË *Knbg.*

ANTINOË PARASITICA *n. sp.*

PL. II, FIGS. 15–22.

A minute form, found under the elytra of *Lepidametria commensalis.* I have never seen a perfect specimen. Of the three found, two were without elytra; the third had a few remaining. Number of setigerous segments, 21.

Head (pl. II, fig. 15), divided into lobes in front by a deep triangular depression which is continued backward to the posterior margin, as a narrow, but well defined impressed line. The widest part of the head is about the middle third, where it is convex at the sides; but the lateral margins both in front and back of this part are slightly concave; dorsal surface convex.

Anterior eyes, situated on the middle line, widely separated, black, crescentic: posterior eyes small, circular, about half-way between the front pair and the posterior margin of the head. Middle antenna lost, except basal article: this last occupies in part the space between the lobes of the head, is large, but not very long. The lateral antennæ are without basal articles; they arise beneath the anterior margin of the head, and are smooth, conical, slightly compressed at base: their length is about half that of the head. Palpi, nearly twice the length of the head, smooth, cylindrical for their inner three-fourths, then suddenly decreasing in diameter.

Tentacular cirri arise from an elongated cylindrical base; superior lost; inferior as long as the head, inner half cylindrical, outer half conical; covered from near their origin for two-thirds of their length with rather coarse papillæ.

Elytra, probably 12 pairs; very minute, transparent, smooth, edge without appendages. They were colorless, with numerous very light brown specks and streaks. They barely covered the base of the feet, not reaching to the middle line of the body. The shape varies, some being as shown in pl. II, f. 16, others as in f. 17.

Dorsal cirri long, projecting beyond the setæ, in all respects similar to the tentacular cirri. Feet long, nearly cylindrical, bilabiate. Dorsal ramus a mere papilla on the upper surface of the foot. Setæ of dorsal ramus (pl. II, f. 18) delicate, one edge very finely denticulated, terminating in a long capillary point. Setæ of ventral ramus of several kinds: first and second setigerous segments, the setæ terminate in a single sharp point, at some distance below which is a long series of sharp teeth (pl. II, f. 20); on the remaining segments, except the last two, the setæ are bidentate, serrate below the apex, the teeth being arranged in short series. The superior terminal tooth is much curved (pl. II, f. 19). In the penultimate segment these setæ are replaced in part by strong hooked setæ; while in the last segment the hooked setæ are the only ones found (pl. II, figs. 21, 22). It seems probable that the function of these hooks is to hold on to the body of *Lepidametria commensalis*, under the elytra of which they are found. Length about 2^{mm}.

LEPIDAMETRIA *n. gen.*

Lateral margins of the head prolonged to form the bases of the lateral antennæ. Middle antenna with distinct basal article. A small facial tubercle. Body elongated, flattened.

Elytra numerous, completely covering the body, or leaving a naked median space of variable width; along the posterior part of the body not always in pairs. Setæ of dorsal ramus, few, delicate: of the ventral ramus for the most part bidentate, but with a few, stouter than the others, pointed.

This genus is closely related to HALOSYDNA *Knbg.* but differs in the number and arrangement of the elytra, in having pointed setæ in the lower ramus, and in having a distinct facial tubercle. In many respects it agrees with LEPIDASTHENIA *Mgrn.*, but is excluded from that genus by having setæ in the dorsal rami.

LEPIDAMETRIA COMMENSALIS *n. sp.*

PL. III, FIGS. 23–31,

Head (f. 23), convex, sides rounded, widest and highest at posterior third, posterior margin slightly concave.

Eyes circular, black, lateral, all small, and in alcoholic specimens seen with difficulty. Anterior pair largest, situated at the widest part of the head. Posterior pair mere specks, half way between the front pair and the hind margin of the head.

Lateral antennæ, bases forming about one-third the length of the entire head; antennæ a little longer than the head. Base of median antenna stout, cylindrical, projecting a little beyond the origin of the lateral antennæ. Middle antenna one-third longer than the lateral. All the antennæ, together with the tentacular cirri and dorsal cirri are cylindrical to near the end, where there is a very slight swelling, after which they taper rapidly, having a filiform termination.

Palpi, stout, extending beyond the middle antenna, decreasing regularly to near the end, where they become suddenly filiform; covered with minute cylindrical papillæ.

Tentacular cirri arise from a long basal article, much enlarged at origin. The superior cirrus is a little shorter than the median antenna; inferior, a little shorter than the superior.

The elytra are smooth, border without appendages. There may be from 38 to 50 on a side. They can not be enumerated in pairs, since opposite sides of the same segment may bear, one, an elytron, the other, a dorsal cirrus. For the first 32 segments the arrangement is uniform; viz: 1, 3, 4, 6,——26, 27, 29, 30, 32. After the 32d segment no two specimens present exactly the same arrangement; even the opposite sides of the same specimen, as mentioned above, differing both in the number and position of the elytra. For example, on one specimen between the 39th and 44th segments, inclusive, was the following arrangement. Right side, elytra on 39th and 44th segments:

Dorsal cirri, 40, 41, 42, 43.

Left side, elytra, 39, 41, 42, 44:

Dorsal cirri, 40, 43.

The elytra (figs. 25, 26, 27) extend along the entire length of the body, and in some cases cover the body completely, but usually there is a naked median space of variable width, and often they do not overlap, or even touch each other in any direction. Anterior pair of elytra circular, elsewhere oval, longer axis transverse, anterior margin emarginate when overlapped by preceding elytron; otherwise rounded. A variable number of posterior segments are without elytra. These segments are very short, and are always covered by the last pair.

The dorsal cirri arise from stout, nearly cylindrical basal articles (f. 28), which are one-third as long as the cirri. They extend a little beyond the foot. Their structure is the same as that of the antennæ, save that the subterminal swelling is even less obvious. The basal article originates a little outside of and behind the attachment of the elytra. Ventral ramus of foot stout, elongate, conical, widely excavated for the transmission of the setæ, and obliquely truncated from above downward. Dorsal ramus a mere papilla. Setæ of dorsal ramus (f. 31) few, delicate, tapering gradually to a minute capillary ending, one edge finely denticulated. One stout concealed acicula.

Ventral setæ in two bundles; superior with one or two stout setæ (f. 29) usually with bluntly rounded apex, beneath which for a short distance one edge is minutely denticulated. In the upper bundle there are also from one to three bidentate setæ. Below the apex on each side is a series of rather long sharp teeth, from 6 to 8 in number. These setæ are not quite so large as those mentioned above. In the lower bundle are from 6 to 12 bidentate setæ every way similar to those of the upper, but a little more delicate (f. 30). All the setæ however are stout and long, except those of the anterior feet which are delicate.

The first ventral cirrus is in all respects similar to the dorsal cirri; its basal article is long, and arises from the base of the foot. After this one they originate at the inner third of the foot from a small papilla. They are minute, conical. At the outer posterior angle of each segment, below, is a small cylindrical papilla, projecting backward and downward, not visible on a few of the anterior segments.

Facial papilla. Just in front of the mouth, beneath the base of the median antenna is a small, facial tubercle or papilla, bluntly rounded externally. Anal cirri two, similar to dorsal cirri. Body very slightly convex above and below.

Color. When divested of the elytra the dorsal surface is usually reddish-purple, with narrow bands of darker purple between the segments. Some specimens again are dark gray, others nearly black. The elytra are transparent, but when removed from the body show a light brown or gray background with numerous dark brown or black spots and blotches. While the elytra remain on the body their circular attachments show through as a series of well marked white spots. Head and facial papilla purple. Antennæ black at base, succeeded by white with brown markings, then comes a black ring corresponding to the enlarged portion; terminal part white. Palpi white. Tentacular cirri, first ventral cirrus, dorsal cirri, and anal cirri colored same as antennæ; the last dorsal cirri and the anal cirri are sometimes darker, or nearly black throughout. Ventral cirri white, flecked with brown at base. Ventral surface same as dorsal. Dorsal setæ, and bidentate setæ of ventral ramus, amber-yellow; single pointed large setæ, dark reddish-brown.

Besides the specimens found in Virginia, one specimen has been found by Prof. Verrill near New Haven, Conn.

Length, 50–90^{mm}.

Breadth, including feet, 5–7^{mm}.

Number of segments, 60–80.

Lives in tube of *Amphitrite ornata* Verrill.

Fam. SIGALIONIDÆ.

STHENELAIS *Knbg.*

Sthenelais picta *Verrill.*

Verr. Invert. Animals of Vineyard Sound, etc., p. 582.

Fam. NEPHTHYDIDÆ.

NEPHTHYS *Cuv*

Nephthys ingens *Stimpson.*

Stimp. Mar. Invert. of Grand Manan, p. 33, in Smithson. Contrib., 1854.
Verrill. Invert. An. Vin. Sound, etc., p. 583, pl. xii, figs. 59, 60.

NEPHTHYS PICTA *Ehlers.*

EHL. Borstenwurmer, p. 632, pl. xxiii, figs. 9, 35,
VERR. Invert. An. Vin. Sound, etc., p. 583, pl. xii, f. 57.

Rare in Va.

Fam. PHYLLODOCIDÆ.

PHYLLODICE (*Sav.*) *Mgrn.*

PHYLLODICE FRAGILIS *n. sp.*

PL. III, FIGS. 32–37.

Body elongated, flattened, widest in the middle, tapering uniformly in both directions, first and last segments very narrow; middle third above, slightly convex; elsewhere, both above and below, flattened.

Head (f. 32) wider than long, very convex, bluntly rounded in front, posterior angles rounded, posterior margin very slightly convex, lateral margins convex, widest at posterior third. Eyes large, circular, black, situated at the widest part of the head, nearly lateral.

Antennæ, inferior slightly longer than superior, all fusiform, stout, not as long as the head. The first segment is longer than the second; it bears three pairs of tentacular cirri. The first pair originate close to the lateral margin of the head, the second, back of and a little within the first, the third, under the second. The second segment bears one pair of cirri (the 4th). The second pair are the longest, reaching back to the fifth segment. The others are about half as long. They all arise from short cylindrical basal articles. Diameter nearly uniform to near the end, where they taper slightly to a bluntly rounded termination.

The incisions for the feet extend inward so far that the feet on each side form one-third of the width of the body.

The feet are crowded, a short free portion is cylindrical, bluntly rounded externally, bilabiate, transmitting a fan of delicate setæ.

The stem of the setæ is much longer than the appendix somewhat flattened near the end, and with a transverse terminal series of minute teeth. The appendix is short, usually curved, wide at base, rapidly diminishing (f. 36), The appendix however may be double the length of the one figured, and less curved.

The dorsal cirri (branchiæ) are somewhat variable in form: but usually broad heart-shaped on the anterior segments (f. 33), becoming somewhat narrower, and less bluntly rounded externally further back (f. 34), while on young specimens, and on recently renewed lost parts, they are narrower, becoming somewhat lanceolate (f. 35). The ventral cirri (f. 37) extend beyond the feet, are nearly cylindrical, bluntly rounded externally.

Anal cirri shaped much like antennæ, may be as long as, or double, the length of the antennæ.

Color. Head greenish-white. Body from light to dark green. All cirri generally yellowish-green. Body and dorsal cirri with numerous, irregularly placed, dark brown spots. On young specimens and on renewed parts the color is always light, and the brown spots few, or absent.

Length of longest specimen 50^{mm}. Greatest diameter of same specimen 2^{mm}.

Found on shells between tides. Occasionally dredged. Common.

EUMIDA *Mgrn.*

EUMIDA MACULOSA *n. sp.*

PL. IV, FIGS. 38–41.

Head (f. 38) convex, rounded in front, posterior emargination distinct but not deep. Anterior antennæ in length about equal to the head, rather stout. Posterior (unpaired), a little shorter, and more delicate than anterior. Eyes posterior, lateral, circular, large, black. Of the tentacular cirri those of the first and second pairs are about half as long as the third; the third (anterior superior), reaches back to the 8th or 9th seg; the 4th about two-thirds as long as the 3d. The first segment is a little longer than the 2d, about equal to the 5th.

Dorsal cirri, on the anterior segments small, lanceolate (f. 39), becoming broader and heart-shaped (f. 40), while on the posterior segments they become again elongate, pointed, but with basal two-thirds of uniform width.

Ventral cirri small, lanceolate, sometimes with one straight and one convex side, reaching slightly beyond the feet; somewhat longer on posterior segments than on anterior.

Anal cirri about the length of the last four segments, arising from a stout basal article forming about one-third their entire length. Terminal portion, subulate, acute. The extended proboscis is about one-third as long as the body. It increases regularly in diameter from its origin, ending in a crown of papillæ. When highly magnified, longitudinal rows of cylindrical papillæ can be seen.

Color of the body, yellowish-white with numerous minute gray spots; appendages white. Dorsal cirri tinged with green.

On shells; 5 to 10 fathoms.

The specimen from which figs. 38, 39, and 40 were made was 3.5^{mm} long. Another specimen was 10^{mm} in length; diameter, 1^{mm}. Number of segments, 65.

Fam. HESIONIDÆ.

PODARKE *Ehlers.*

PODARKE OBSCURA *Verrill.*

VERR. Invert. An. Vin. Sound, etc., p. 589; pl. xii, fig. 61.

Six to twelve fathoms, on shells. Rare.

Fam. SYLLIDÆ.

SYLLIS (*Sav.*) *Ehlers.*

SYLLIS GRACILIS *Grube.*

GRUBE. Actinien, Echinodermen und Würmer, p. 77.
CLAPARÈDE. Glanures Zoötomiques parmi les Annélides de Port-Vendres, p. 75, pl. v, f. 3.
CLAPARÈDE. Annel. Chétopodes du G. de N., p. 503, pl. xv, f. 3.
MARION ET BOBRETZKY: in Ann. des Sciences Naturelles, 6th series, vol. xi, p. 23, pl. ii, f. 6. (1875.)

The specimens from Virginia agree perfectly with the descriptions given by Grube and Claparède. As remarked by Marion and Bobretzk, the figures of the furcate setæ given by Clpd. are very inaccurate. Those of M. and B. are very good, and removed the last doubt as to the identity of the Virginian specimens with *S. gracilis* Gr. They are, however, smaller than even those described from Port-Vendres, the largest specimen being only 11^{mm} long.

In some specimens the furcate setæ extend to the last segment, to the complete exclusion of the compound setæ; in others both furcate and compound setæ occur on a variable number of posterior segments, while on others again, the compound setæ entirely replace the furcate on a few of the posterior segments.

Common on Oysters at low water, and on dredged shells, from 4 to 12 fathoms.

SYLLIS FRAGILIS *n. sp.*

PL. IV, FIGS. 42, 43.

Head convex, anterior and posterior margins nearly straight lines, passing into the rounded lateral margins. Width double the length.

Eyes six. Anterior pair mere specks just outside the bases of lateral antennæ; middle pair at posterior third of head, lateral, large; posterior pair a little smaller than the middle, back of and within the latter, but almost touching them; all dark red. Median antenna, arising between median pair of eyes, is always very long, but varies, being from 5 to 8 times the width of the body. Lateral antennæ about two-thirds as long as the median. Superior tentacular cirrus as long as median antenna; inferior, length of lateral antennæ.

Palpi, portion projecting beyond the head slightly longer than the head. They are broad, flattened, inner two-thirds of uniform width, outer third with external margin curved inward, internal margin straight, end bluntly rounded. They are free and diverge for their outer two-thirds, united by a membrane along their posterior third.

The dorsal cirri arise from short stout basal articles (or elevations of the body). Their length varies from four to eight times the width of the body. There is a strong tendency to alternation between the shorter and longer cirri. Anal cirri two, as long as the last 6 or 8 segments taken together. The antennæ, tentacular cirri, dorsal cirri and anal cirri are alike in form and structure. They are uniform in diameter from end to end, are not composed of distinct articles but are wrinkled, and sometimes so regularly as to give the appearance of distinct annulation. All are covered with short stiff hairs.

Ventral cirri arise about half-way out on feet. Anterior not projecting beyond the feet, but the posterior often reaching slightly beyond. They are delicate, conical.

The œsophagus reaches to the 4th or 5th segment. Anterior end with a circle of small, flattened, triangular papillæ; one stout conical tooth. The stomach is about the same length as the œsophagus, reaching to the 9th or 10th segment. Back of the stomach, a pair of lateral glands.

The feet are uniramous, conical, bilabiate, in length equal to the width of the body. The setæ (f. 42) are numerous, arranged in a fan, the upper as long or a little longer than the foot, each lower one becoming a little shorter. All are long. There are one or two (f. 43) aciculæ in each foot, which are straight, taper uniformly, and end in a small enlargement (button). The last 6 or 8 segments taper slightly; otherwise the body is of uniform width.

The general color of the dorsum is yellowish-white; feet and sides, white; ventral surface same as dorsal. Between the segments runs a dirty or brownish-white line, and there is a similar line between the bases of the dorsal cirri on each segment. The ground color is interrupted by numerous dark brown spots or specks, for the most part arranged in transverse lines. These spots are dark and very numerous on the dorsal and lateral surfaces of the feet.

Sexual Forms.

The males and females of this species do not differ much from each other or from the stem form. I did not see many examples of either sexual form, and most of these were mutilated. So far as I was able to determine, the capillary (sexual) setæ in the male begin on the 11th or 12th segment, and fail on the last 8. They were short, not reaching beyond the feet. This part of the body was slightly swollen; color, pure white.

In the female, the capillary setæ begin on the same segment as in the male; they fail on the last 10 segments, are very long, double the length of the feet and ordinary setæ taken together. The eggs are brown, and determine the color of this part of the body. The anterior and posterior segments have the usual color of the stem form. On all sexual specimens, and on many that could not be determined as such, there is a dark brown crescent at the base of each foot (ventral surface).

Number of segments, in one specimen 38, in another 44. Length, 4 to 5^{mm}.

ODONTOSYLLIS *Claparède.*

ODONTOSYLLIS? FULGURANS *Clpd.*

CLAPARÈDE. Glanures Zoötomiques, etc., p. 95, pl. viii, f. 1.
QUATREFAGES. Hist. des Ann., ii, p. 648.
MAR. ET BOBR : in Ann. des Sci. Nat., 6th series, vol. ii, p. 40, pl. iv, f. 11.

I am in doubt as to this form; in many respects it agrees perfectly with *O. fulgurans*, but in color, and in the structure of the feet and ventral cirri, it agrees better with *O. Dugesiana* (*Glanures Zoöt.*, p. 97, pl. 8, f. 2.)

On the whole, my specimens seem to confirm the supposition of MAR. and BOBR. (l. c. p. 41) that *O. fulgurans* and *O. Dugesiana* are not distinct species.

Sexual forms: male not found; female, two specimens. In one, the capillary setæ begin on the 21st setigerous segment, and exist on 14 segments, followed by 28 segments with compound setæ only; some few of the posterior segments lacking. In the other specimen the sexual setæ are on 19 segments, beginning with the 21st; rest of body lost. In both, the body back of the 20th segment was pure white, swollen with eggs, as far as the sexual setæ extended. On one specimen, the dark crescents described under *S. fragilis* were seen, in the other, not. In the second female mentioned above, the eggs were very large, evidently nearly mature, and the eyes on each side had coalesced.

Found on shells, stones, etc., dredged from 6 to 12 fathoms.

Length of a sexual form, from 4 to 12^{mm}.

Length of a nearly entire female, containing 64 segments, 12^{mm}.

SPHÆROSYLLIS *Clpd.*

SPHÆROSYLLIS FORTUITA *n. sp.*

PL. IV. FIGS. 44–48.

Head oval, slightly convex, length to breadth as 1 to 2 (f. 44). Eyes four, large, oval; anterior pair at posterior third of the head, lateral; posterior pair just within and but little back of the anterior.

Antennæ fusiform, equal, two-thirds as long as head and palpi taken together. The unpaired antenna originates between the posterior eyes; the lateral just in front of the anterior eyes. The palpi are large, rounded externally, bluntly rounded in front, united along their inner two-thirds, outer third free, but not diverging. There is a wide and deep depression between the palpi, extending from the head to the free portion.

First segment narrow, but perfectly distinct from the head.

Tentacular cirri similar in all respects to the antennæ.

Dorsal cirri, a trifle shorter than the antennæ, and not quite so much enlarged at base, especially on the posterior segments.

The anal cirri are double the length of the dorsal cirri, constricted at base; their diameter increases slightly along their inner half, when they are somewhat suddenly constricted, the outer half having about one-half the greatest diameter of the basal half (f. 45).

Ventral cirri, arise from base of feet, delicate, cylindrical, in front as long as the feet, longer behind and turned backward on a few of the posterior segments.

Feet very stout, cylindrical, bilabiate. The œsophagus reaches to the middle of the 5th segment. The stomach barely reaches into the 7th. The œsophagus has a covering of pigment, interrupted by a narrow clear band in the anterior part of the 4th segment.

Body convex above, segmentation well marked. A few of the anterior segments taper slightly. The body attains its greatest width at the 7th segment, remaining unchanged to the last 8 segments, whence it tapers quite rapidly. Anal segment narrow, without appendages save the anal cirri.

Small fusiform papillæ are scattered irregularly between the feet, and at their bases, much more numerously in the middle of the body than at either end.

Setæ, very short and of three kinds, two of which are compound. One form has a stout basal article (f. 47), a little longer than the appendix; there are 3 to 5 of these in each bundle. The second form (f. 46), longer than the first, has the appendix elongate, delicate, a little longer than the stem, one or two to each foot; in both, the edge of the appendix is beset with short, stiff hairs. Of the simple setæ (f. 48) there is usually but one, sometimes two to each foot.

Length, 3. 5^{mm}; greatest diameter, 0.25^{mm}. Number of segments, 33.

A single specimen; not recognized when collected, but found afterwards in perfect condition in a lot of PÆDOPHYLAX.

In many respects this species is similar to *S. pirifera* Clpd. (*Ann. de Naples*, p. 515, pl. xiv, f. 2), but differs from it in the shape of the head, in the free terminal part of the palpi, in the position of the eyes, and in the form of the antennæ and cirri.

I have referred this species to SPHÆROSYLLIS, though somewhat in doubt as to whether the name can be retained for it. Claparède's original diagnosis of the genus was defective and his figures misleading. Ehlers would seem to have been perfectly justified in ascribing to the genus five antennæ, no tentacular cirri, first segment with same appendages as the second: and in referring to the genus thus limited his new species *S. Claparèdii* (*Die Borstenwürmer*, p. 252, pl. ix, figs. 10–13). Claparède afterwards corrected his generic diagnosis, and gave a new figure of his type species *S. hystrix* (*Glanures*, p. 85, pl. 6, f. 1), but this was subsequent to the publication of Ehlers' work. In any case, if *S. hystrix* is to remain the type of the genus SPHÆROSYLLIS, then *S. Claparèdii* Ehlers, must be the type of a new genus.

PÆDOPHYLAX *Clpd.*

Annelides Chétopodes du Golfe de Naples p. 520.

Claparède draws one of his generic characteristics from the position of the eyes, assigning one pair to the buccal segment. This is not the case with the following species. In fact, it is not true even of *P. veruger* Clp., in which they are found in the depression between the head and buccal segment.

PÆDOPHYLAX DISPAR *n. sp.*

PL. IV, FIG. 49. PL. V, FIGS. 50–55.

Head (f. 49) convex, rounded in front and at the sides, posterior margin nearly straight, length to breadth as 1:2.

Eyes four, large, circular, lateral. Posterior pair a trifle smaller than the anterior, a little within, almost in contact with them, very near the posterior margin of the head.

Palpi: length of projecting portion nearly double the length of the head, convex, rounded laterally, diminishing forward, front bluntly rounded and slightly emarginate; above, the palpi are separated by a slightly impressed line; below, by a depression which widens and deepens behind.

Antennæ: median, arising near posterior margin of head, reaches nearly to the end of the palpi, fusiform;

lateral, arise just within anterior eyes, minute, mere papillæ, fusiform. Tentacular cirri, similar in all respects to lateral antennæ.

Dorsal and ventral cirri a little larger than the lateral antennæ; otherwise, the same.

Anal cirri two, slightly constricted at base; for the rest, subulate, in length about equal to last three segments, or to middle antenna. On one specimen there were three anal cirri, all of the same length.

Feet fleshy, swollen, in length about one-third the width of the body, a little longer than the dorsal cirri, bilabiate.

Setæ: on the anterior segments three or four with very short curved appendix (f. 51); one with capillary appendix (f. 52); one simple seta, slightly curved near the end (f. 54). On the posterior segments two or three of the first kind, one of the third, and one similar to the third, but more curved (f. 55).

Body of nearly uniform width in the anterior half; posterior half, tapering gradually, the last segment being about one-third the width of the middle segment. Number of segments, from 20 to 40. Length, 2 to 4^{mm}; diameter, 0.25 to 0.5^{mm}.

Color: either colorless, or white with a slight reddish tinge. Usually there is a white line between the segments.

Œsophagus, extends to the middle of the 5th segment.

Stomach white, extending to the middle of the 8th segment.

Common on shells, stones, etc. Dredged, 4 to 10 fathoms.

AUTOLYTUS (*Grube*) *Marenzeller*.

Ehlers (*Borstenwürmer*) gives as a leading characteristic of Autolytus and Proceræa the failure of palpi. Claparède (*Glanures*) says of Autolytus, " Palpi (lobes frontaux) not projecting;" and in his *Ann. du G. de N.* adopts Ehlers' diagnosis of PROCERÆA. Marion and Bobr. (*Ann. des Sci. Nat.*, Series vi, vol. 2) assign palpi to their *Autolytus* (*Procerœa*) *ornatus*. They regard PROCERÆA as a subgenus of AUTOLYTUS.

Finally, Marenzeller (zur *Kentniss der adriatischen Anel.* aus dem lxxii Bande *der Sitzb. der K. Akad. der Wissensch.*) states that *Procerœa picta* Ehlers (type of the genus) has palpi, as well as two species described by himself (*P. luxurians* Mar., *P. macrophthalma* Mar.). He accordingly corrects (l. c. p. 37) Ehlers' diagnosis of the genus, and adds that the same is true for AUTOLYTUS. The following species will be seen to bear out this conclusion.

AUTOLYTUS HESPERIDUM *Claparède.*

CLPD. Annel. Chétopodes du G. de N., p. 526, pl. xiv, fig. 1.

My specimens agree with *A. hesperidum* Clpd. in every particular, save that they certainly possess projecting palpi. These form a thin rim, projecting a variable distance beyond the head, plainly divided below, separated above only by a shallow depression. The head proper is transversely oval, thicker and more convex than the projecting part. The outline of head and palpi together is exactly that given by Claparède. In the position of the central antenna given in his figure, the line between the palpi is of course concealed. This is often the case both in living and in alcoholic specimens. In fact, I examined a number of specimens without observing the palpi. When I did see them, I supposed that my previous identification was incorrect. It was, however, impossible to make a description, by which my specimens could be distinguished from *A. hesperidum.* I had not at that time seen the observations of M. and B., and of Marenzeller, cited above, by which my views have been confirmed. I can not find that *A. hespe-*

ridum has been examined by any one since it was described by Claparède. The extent of the projecting portion of the palpi is somewhat variable, but if in Claparède's figure (pl. 14, fig. 1), a curved line be drawn, passing just in front of the origin of the lateral antennæ, terminating on either side opposite the anterior (minute) eye on that side, the usual condition will be represented. Add, that though the antennæ often are as given by Claparède, in some specimens, the central antenna is longer than the lateral, sometimes as long as the first dorsal cirrus; also, that while both kinds of anal cirri (Clpd. l. c., pl. 14, f. I A) occur, I have never seen both on the same specimen.

Sexual Forms.

Female differs from the stem form in the following points: the head is very short, length to breadth as 1 to $2\frac{1}{2}$; middle third of anterior margin curving sharply backward, the antero-lateral portions appearing as rounded projecting lobes.

Antennæ, both median and lateral, arise from the anterior margin of the head; they are equal in length, being much shorter than those of the stem form.

Anterior eyes very large, posterior pair a little within the anterior, but nearly touching them. The anterior minute eye-specks of the stem form not seen.

The tentacular cirri, and dorsal cirri of the first segment, bear the same relation to the antennæ as in the stem form.

The capillary setæ are very long, beginning on the 4th, 5th, or 6th segment; not found on the last 4 to 7. Feet much swollen at base.

Eggs, very large, generally crowded, and then irregularly polygonal, otherwise spherical, their diameter about one-half the width of the body; of a dark purple color, with an eccentric clear nucleus.

Color of the body determined by the eggs, wherever they exist; elsewhere the same as in the stem form.

Number of segments, from 24 to 30. Length, 3 to 4^{mm}. Greatest diameter, 1^{mm}.

Specimens of the mature female occurred through July and August. They are quite delicate, and were very uneasy, swimming about constantly and rapidly, with a quick, undulatory motion. All the features mentioned above seem to originate after separation has taken place. I often found the stem form with eggs giving the characteristic purple color in the posterior segments, and with the separation carried so far that the slightest touch served to complete it, but in only one case did I find antennæ or tentacular cirri formed, or the peculiar outline of the head indicated, before separation. In this one specimen the antennæ and tentacular cirri were mere buds, the first segment was without feet; but the eyes and capillary setæ had not appeared.

Male. No adult male was found. The posterior segments of the stem often contained very fine granular matter, which I believe was the male element; it gave a very bright orange color to the segments in which it was found. No other change had taken place in these segments, though the division was often nearly complete, as mentioned above in the case of the female.

This species was common on shells, etc. Dredged, 4 to 12 fathoms.

PROCERÆA (*Ehlers*) *Marenzeller*.

EHLERS. Borstenwürmer, p. 256.
MARENZELLER. Zur Kentniss der adriatischen Anneliden, zweiter Beitrag, p. 37.

For remarks on this genus see under AUTOLYTUS.

PROCERÆA TARDIGRADA *n. sp.*

Head, quite thick, transversely oval, convex; head and palpi together nearly circular; palpi much the same as in *Autolytus hesperidum*; very thin, and the dividing line above not well marked, but existing.

Eyes small, circular, umber-brown, on the posterior part of the head, four in number; the anterior pair lateral, the posterior pair just within the anterior, very near the posterior margin of the head, smaller than the anterior.

Antennæ: the median arises between the anterior eyes, and when turned backward, reaches to the 8th segment; the lateral arise just in front of the anterior eyes, and are from one-third to one-half as long as the median.

Tentacular cirri: the superior about as long as the lateral antennæ; inferior one-half as long.

First dorsal cirrus, nearly as long as median antenna. Second dorsal cirrus, one-half as long as first.

The antennæ and tentacular cirri habitually coiled in a flat or a conical spiral. Antennæ, all superior cirri, and anterior margin of palpi, with numerous short, stiff hairs.

Dorsal cirri, a little less than width of body in length.

Anal cirri, two in number, a little longer than the longest dorsal cirri. The antennæ and all the cirri are irregularly wrinkled, and have nearly the same diameter from end to end.

The proboscis terminates in rounded fleshy lobes; the œsophagus, in a circle of flattened triangular papillæ. It extends to the 8th segment, doubling twice on itself just before entering the stomach. The stomach occupies from three to four segments.

Feet large, fleshy, cylindrical, bilabiate, anterior lobe slightly longer than posterior; incision between the lobes very shallow. They originate along the line of union of the lateral and ventral surfaces, and are directed downward.

Setæ arranged in a single series, and directed downward and backward; on the anterior segments about twelve to each foot, decreasing in number backward, till on the last segments there are only three or four. Body very convex above, flat below; width of the first fourteen segments uniform, after the 14th decreasing gradually to the minute terminal one.

The 1st, 2d and 3d segments are short; 4th and 5th equal in length and width; 6th to 14th, inclusive, length double the width; after the 14th, they become gradually shorter, the last ones being very short and crowded.

Color: general color of body yellowish-white. Antennæ, front of head and all cirri, white. Posterior part of head and first segment (in one case the second also), dark brownish-red. Between the eyes there is a narrow band, extending back to the middle of the first segment, of a darker shade than that of the head generally; and from the posterior eyes, on each side a similar line runs back to the third segment. Bands of the same color as the head cross the posterior part of the following segments (extending to the ventral surface, but not crossing it), viz: from the 3d to the 11th inclusive, 14th, 17th, 20th, and on every fourth segment after the 20th, except that the last three are on consecutive segments, and not well marked. On the anterior part of the body the width of these bands is about one-half the length of the 4th segment. As the segments shorten, after the 14th, this band also grows narrow. The lower surface of the base of the dorsal cirri, after the 7th, has a spot of the same color.

The movements of this species are peculiarly slow, the direction of its feet and setæ are such that it seems to *walk* on the tips of its setæ.

Length of specimen described, 11^{mm}; greatest diameter, 1^{mm}.

Number of segments, 80.

Length of head and first 14 segments, 5^{mm}.

On one specimen (lost before the examination was finished) a new head was forming back of the 14th segment.

Short antennæ had appeared, the lateral being bifurcate at outer third. The dorsal cirrus of the next segment had doubled its length.

On another specimen, there was a sudden falling off in width back of the 14th segment, while two other specimens had lost all save the first fourteen segments. It would seem that the separation of the sexual from the stem form takes place between the 14th and 15th segments.

Dredged: 4 to 12 fathoms; on shells, etc.

PROCERÆA? CŒRULEA *n. sp.*

The following notes were made upon two specimens, taken in August, both females, badly injured, and lost by accident before the examination was completed. They belong either to PROCERÆA or AUTOLYTUS; their mutilated condition did not admit of a positive generic reference.

Body, strongly convex above, flat below.

Eyes four; the anterior pair very large; the lateral, convex, nearly terminal; the posterior eyes, smaller, dorsal.

Antennæ: median very long, arising back of anterior eyes; lateral, half as long as median, arising just in front, and a little outside of, anterior eyes.

Tentacular cirri and dorsal cirri of first and second segments, too badly injured to admit of description. Dorsal cirri quite long, reaching to end of the capillary setæ.

Feet same as in *P. tardigrada;* first six with a fan of short, dark colored setæ; capillary setæ from the 7th to the 21st segments inclusive, followed by a few segments without them.

Color: dark blue both above and below, with perfectly black transverse bands, not crossing the ventral surface. Base of feet dark brown. Body filled with large eggs.

Found with *P. tardigrada.* Dredged: 4 to 12 fathoms; on shells, etc.

Fam. NEREIDÆ.

NEREIS (*L.*) *Cuv.*

PL. V, FIGS. 56–64. PL. VI, FIGS. 65–69.

NEREIS IRRITABILIS *n. sp.*

Body of nearly uniform size throughout the anterior three-fourths; posterior fourth tapering slightly. Number of segments over 200.

Head (f. 56) convex, broadest between the anterior eyes, where the breadth nearly equals the length, decreasing slightly behind, rapidly in front.

Eyes, circular, small, lateral; front pair placed at posterior third; posterior pair near the back of the head, half the diameter of the front pair.

Antennæ, arising close to each other, delicate; length a little more than half the length of the head.

Palpi, about as long as the head, diverging rapidly, extending a little beyond the antennæ; basal portion stout; terminal article slender, elongate.

First segment, as long as the following segments, arching forward, so as to encroach slightly on the head.

Tentacular cirri, 4th reaching to 5th segment; 2d one-third to one-half as long as 4th; 1st and 3d, a little shorter than 2d, equal.

Feet (figs. 58–62), on the anterior part of the body, compact. Superior lingula stout at base, conical, reaching a trifle beyond the upper ramus. The upper lip of the superior ramus is a mere papilla on the anterior basal portion of the lower lip. The lower lip has the same form as the upper lingula, but is a little shorter, and not quite so large at base. The lower ramus is a little shorter than the upper, is divided by a shallow incision into anterior and posterior lips, of which the anterior is slightly the longer, and is further divided at the end into two rounded lobes, upper and lower. Lower lingula, similar to upper, but shorter; after the first few segments projecting a little beyond the lower ramus.

Dorsal cirri, delicate, conical, not quite reaching the end of the upper lingula.

Ventral cirri, similar to dorsal cirri, but shorter; they arise below (within) the base of the lower lingula from a slight elevation, and reach about to the middle of the lower lingula. Further back the upper lip of the dorsal ramus becomes smaller and finally disappears. The posterior lip of the ventral ramus also disappears, and the terminal division of the anterior lip into lobes becomes less marked. The ventral cirri shorten and recede from the lower lingula, while the feet have their basal portion much elongated.

Setæ, all of one kind on the anterior feet (f. 63). Appendix slender, acute, edge beset with numerous short hairs. Terminal points of stem in the same plane (*Aretes homogomphes* Clpd.). They are arranged in three bundles, one in the dorsal ramus, two in the ventral. Ventral setæ very numerous and crowded. Falcate setæ (f. 64) occur first between the 30th and 40th segments; at first in the lower bundle, few in number; becoming more numerous, they occur also in the upper bundle of the lower ramus, but never entirely replace the first form, and disappear again in the posterior segments.

Proboscis (f. 57) about twice the length of the head.

Paragnathi, i, fail; ii, 6 to 10 in small bunches; iii, 2 or 3 irregular transverse rows; iv, 10 to 12 in bunches. All black, small, conical, the inferior (iii), smallest; v, vi, vii, viii, fail.

Jaws, usually light horn color, with dark brown or black edges and tips; curved, twisted externally; denticles small, number variable. In the dorsal ramus there is always one black acicula; in the ventral usually but one, sometimes two or three.

Every specimen found had lost the anal segment.

Dug at low water; mud and sandy mud.

Female. In the adult female the first 33 segments correspond to those described above. The only change consists in a slight enlargement of the eyes. Changes beginning with the 34th segment, and completed at the 40th are as follows (f. 65). At the base of the dorsal cirrus a small membranous plate appears. The lingulæ, and the lower lip of the dorsal ramus, become flattened lanceolate. In the lower ramus the two lobes of the anterior lip are enlarged and flattened, and an additional circular membranous plate appears. At the base of the ventral cirrus a small membranous plate is developed above, and a much larger one below.

At about the 100th segment, a change to the normal form begins. The dorsal cirrus, upper lingula, and dorsal ramus are first affected, next the lower ramus, and last of all the ventral cirrus. This change is nearly as well marked and sudden as in the anterior part.

Setæ: in the changed feet, the ordinary setæ are nearly replaced by cultrate setæ (f. 66), a few, however, remaining in the lower ramus.

Anal segment elongate, striate above.

Anal cirri filiform, in length equal to the last eight segments.

Number of segments, 170 to 220.

Length, 60 to 80^{mm}; greatest breadth, including feet, 5^{mm}.

Color: anterior segments pearl-gray; middle segments blue; base of feet green; posterior third of body gleaming, brassy.

Taken while swimming on the surface from Aug. 1 to Aug. 12. During this time 15 females were taken and

115 males; they were simply dipped up with a scoop-net, indiscriminately, no attempt being made to collect one form rather than the other.

Immature Female. Some specimens dug at low water, July 21, had their bodies well filled with eggs, but were otherwise unchanged, save that the bases of the feet were swollen and elongated.

Color: above pearl-gray, beneath, darker, in some cases light purple. Feet white.

Adult Male. Taken with female. Specimens very numerous, as noted above. The 5th, 6th and 7th dorsal cirri are longer and larger than the others. This is particularly the case with the 7th (f. 68). The 8th cirrus is normal (f. 69).

Change in structure of feet begins on the 34th segment. The development of the membranous plates is better marked in the male than in the female. Those at the bases of the cirri are much larger, and the circular plate on the lower ramus is very large (f. 67).

Color: anterior segments pearl-gray. After the 33d segment, body and base of feet above and below, red; tips of feet white. On each side of the body, both above and below, a narrow white line. Extreme posterior segments sometimes green, sometimes brassy, gleaming; anal segment with a crown of close set papillæ.

NEREIS DUMERILLII *Aud. and M. Ed.*

AUD. and M. ED. Ann. des Sci. Nat., vol. xxix, 1833, p. 218, pl. xiii, figs. 9–12.

(For full description, synonomy, and figures see Ehlers, Borstenwürmer, p. 535; also Claparède, Appendix Ann. Chét. du G. de N., p. 44.)

Three specimens were found, all more or less injured, but certainly belonging to this species. Dredged.

Nereis virens *Sars.*

Nereis virens Sars. Beskrivelser og iakttagelser, etc., p. 58, pl. x, f. 27.
" " Ehlers. Borstenwürmer, p. 559, pl. xxii, figs. 29–32.
" " Verrill. Invert. An. Vin. Sound, p. 590, pl. xi, figs. 47–50.
Nereis grandis Stimp. Invert. of Grand Manan, p. 34, f. 24.
Nereis yankiana Quat. Hist. des Annelés, vol. i, p. 533, pl. xvii, figs. 7–8.
Alitta virens Knbg. Annulata Nova, p. 112.
" " Mgrn. Nord. Hafs-Ann., p. 183.— Annulata Polychæta, p. 172, pl. iv, f. 19.

One specimen only was collected.

Nereis limbata *Ehlers.*

PL. VI, FIGS. 70-75.

Ehlers. Borstenwürmer, p. 567.
Verrill. Invert. An. Vin. Sound, etc., p. 590, pl. xi, f. 51; also p. 318.

My specimens, in most particulars, agree perfectly with Ehlers' description, but there are some not unimportant differences. Ehlers states that the dorsal cirri do not extend beyond the lingulæ. This is the case with my specimens until the lingula is enlarged and flattened. Again Ehlers states that the dorsal cirrus, borne by the lingula, is never terminal. I find that on a few of the posterior segments it is terminal (figs. 70–71). I have received from Prof. Verrill specimens referred by him to Ehlers' species which agree perfectly with mine. Verrill (l. c. p. 318) says of the females that "the middle region does not become different from the anterior, as in the male." Up to the time of the reception of the above specimens of adult males, it was my belief that the sexual forms were alike, and that no great change occurred in either. In fact, the changes in the adult male are as well marked as in any species observed by me. Certain changes also occur in the females. The eyes are enlarged so as nearly to touch each other. On the 18th setigerous segment small membranous plates appear at the base of the ventral cirrus, and a similar somewhat larger plate on the lower ramus (f. 73). On the segments thus changed the cultrate (sexual) setæ nearly replace all other forms. In males, with feet changed to the same extent, there were no cultrate setæ. In both male and female, the anal segment is crenulated, and shorter than in the asexual form (f. 71). In both, the feet were much swollen at base. It would not be safe to assume that the changes in the female stop at the point indicated above; for although they seemed to be adult, yet so did the males, and yet Prof. Verrill has shown that the changes in the adult male are much greater than appeared probable from the condition of my specimens. The change in the anal segment occurs first. Many specimens, in which the sexual elements were perfectly distinct, were unmodified, save in the anal segment.

Low water, mud and sandy mud: often in very soft mud, brackish water, being the only annelid that I found living under such conditions. This last station was very near high water mark.

Fam. EUNICIDÆ.

DIOPATRA *Aud. and M. Ed.*

DIOPATRA CUPREA *Clpd.*

Nereis cuprea BOSC. Hist. Nat. des Vers, vol. i, p. 143.
Eunice cuprea QUATR. Hist. Nat. des Annelès, vol. i, p. 331.
Diopatra cuprea CLPD. Annel. Chétopodes du G. de N., p. 432.
" " VERR. Invert. An. Vin. Sound, p. 593, pl. xiii, figs. 67, 68.

I have never seen Bosc's work. The synonomy given above rests on the authority of Claparède.

Common, especially near high water mark.

MARPHYSA *Quat.*

MARPHYSA SANGUINEA *Quat.*

PL. VI, FIGS. 76–80. PL. VII, FIGS. 81–83.

Nereis sanguinea MONTAGU. Linn. Trans., xi, p. 20, pl. iii, f. 1.

Leodice opalina SAV. Syst. des Ann., p. 51.
Nereidonta sanguinea BLV. Dict. Sci. Nat.
Eunice sanguinea AUD. & ED. Ann. Littoral de la France, p. 147.
" " GRUBE. Fam. der Annel., pp. 44, 123.
" " " Die Insel Lussin.
" " " St. Malo and Roscoff.
" " LEIDY. Mar. Invert. Fauna R. I. and N. J., p. 15.
" " JOHNSTON. Cat. of Worms, p. 134.
Marphysa sanguinea QUATR. Hist. Nat. des Ann. vol. i, p. 332, pl. x, f. 1.
" " EHLERS. Borstenwürmer, p. 360, pl. xvi, figs. 8–11.
" " BAIRD. Linn. Proc. Zoölogy, vol. x, p. 352.
" " MAR. & BOBR. Ann. des Sci. Nat., vol. ii, p. 12. 1875.
" *Leidii* QUATR. Hist. Nat. des Ann., vol. i, p. 337.
" *Leidyi* VERR. Invert. An. Vin. Sound, pp. 319, 593, pl. xii, f. 64.

Prof. Leidy first reported this species from our coast. I have no doubt as to the accuracy of his identification. Quatrefages changed the 16 of Leidy's description into 60, in translation, and gave to this new (hypothetical) form a new name, *M. Leidii.* This mistake seems to have passed unnoticed. In regard to Leidy's statement that the branchiæ begin on the 16th segment, it is probable that he examined only small specimens in coming to this conclusion. It will be seen below that the branchiæ may begin on any segment from the 10th to the 23d.

Young Stages: This species abounded in individuals in all stages of growth from 2.5^{mm} to over 20 centimetres in length. The gradation was perfect, and the results seem interesting.

(*a.*) Youngest form taken: two specimens, 18 and 22 setigerous segments. No antennæ; no branchiae; no indication of division of the head into lobes (palpi) above or below.

Eyes five, situated as in f. 81. These specimens agree with this figure in every particular, except the slight emargination of the head, and in the presence of an antenna.

The feet are fleshy rounded lobes; the dorsal cirri blunt, finger shaped, extending a little beyond the feet. Ventral cirri swollen at base, outer third suddenly attenuated.

Setæ, in two bundles. Upper bundle made up of two or three compound setæ, appendix short, bidentate (f. 76), and one simple seta (f. 77), long, acute, with a narrow border; one straight black acicula (f. 79). Lower bundle, two or three of the compound bidentate setæ; one compound seta (f. 78), with a long, narrow, acute appendix; one bidentate acicula (f. 80).

(*b.*) In the next stage there is a slight depression of the anterior margin of the head, one antenna, as in f. 81; the bidentate setæ have disappeared from two or three of the anterior segments, the other forms (figs. 77, 78) are more numerous. In other respects same as (*a*). Length, 2.5–4^{mm}.

(*c.*) As a next step, the anterior emargination becomes a little deeper, and a shallow median depression extending back a short distance, above and below (f. 81), indicates more clearly than before the future division of the head into palpi. Simple finger-shaped branchiæ appear on the 10th setigerous segment. On a specimen with 36 setigerous segments there are 13 pairs of branchiæ; of these the first two, and the last three, are shorter than the others.

Length, 4^{mm}.

(*d.*) In the next form, there are three antennæ. In one specimen the lateral antennæ are mere buds (f. 82). Eyes four to two. The median eye disappears first, next one or both of the anterior eye specks, so that on specimens otherwise the same there may be two, three, or four eyes. The division of the head into palpi becomes better marked. The shape of the feet becomes somewhat changed; the bidentate setæ gradually disappear from the anterior segments, until on the largest of the series they are found only on the posterior third; a second straight acicula is added to the upper bundle of setæ, and a second bidentate acicula to the lower bundle. The branchiæ are simple, and begin from the 10th to the 13th setigerous segment. Length, 9^{mm}. Number of segments, 75.

(*e.*) We have next five antennæ, the external in some cases being minute papillæ, in others having attained their normal (relative) length. On small specimens the division of the head into palpi is not complete. Branchiæ begin on any segment, from the 10th to the 23d, according to the size of the specimen. Eyes, always two.

On specimens from 10 to 20^{mm} in length, having more than 10 and less than 17 non-branchiated anterior segments, the branchiæ are usually bifurcate.

The jaws of the youngest forms correspond perfectly with those of adults, save that the support (Träger) is relatively longer, and with a narrower posterior margin. In this, as in all other respects, a complete gradation can be established.— My figures of jaws all show four teeth on the large denticulated jaw pieces (Zähne, Ehlers), as described by Quatrefages, instead of three, given by Ehlers.

The comb-like setæ of the adult are not found on the youngest forms. I have never seen them on specimens with less than three antennæ, nor on those without branchiæ.

The forms under (*c*) will be seen to correspond very closely to *Nematoneries oculata* Ehlers (*Borstenwürmer*, p. 374, pl. 16, figs. 19–22), while (*d*) is very close to AMPHIRO *Knbg.* (*Annulata Nova Öfvers af K. Vet-Akad Förh.*, 1864 p. 565; also *Fregatten Eugenien's Resa*, pl. xvii, f. 26). Kinberg says in his generic diagnosis: "Branchiæ pectiniformes vel subpectiniformes," and for the most part (*d*) has simple branchiæ, but on one specimen the branchiæ were found divided, the second division being represented by a small but perfectly distinct papilla. Possibly, then, Amphiro may be a young form of Marphysa or of some related genus.

DRILONEREIS (*Clpd.*). Char. emend.

Feet uniramous, setæ simple, no ventral or dorsal cirri; lower jaw pieces present, absent, or rudimentary. Upper jaw, on each side, four pieces similar to those on the opposite side, in addition to the support.

Claparède (l. c.) gives as a characteristic of his genus Drilonereis: "Labrum nullum." The following species seems to belong to this genus, but it may have two pieces in its lower jaw, or one with the rudiment of the other; or one alone, or finally none at all.

Driloneris longa *n. sp.*

PL. VII, FIGS. 84-88.

Head, in the living animal, variable in dimensions; conical, round above, flattened below, bluntly rounded in front.

First two segments equal in length; no appendages.

Feet, on first 30–40 segments, consist of a low rounded elevation, from the summit of which project a few simple, bordered setæ, and one stout acicula. Next appears a minute papilla projecting from the lower back part of the foot; it gradually becomes longer, and extends beyond the foot (f. 84). Meantime the foot itself becomes longer and cylindrical. The posterior lip, which, when it first appears, is about at the outer third of the foot, moves outward, and becomes terminal. Next a papilla appears on the anterior margin of the foot, which gradually elongates and becomes in every respect similar to the posterior lip. These two lips diverge from each other, and between them is the rounded end of the foot from which the setæ project (f. 86). These changes take place very gradually, the feet represented in f. 86, being found only on the posterior third of the body.

Jaws (f. 88). The elongated pieces of the support are not attached in front to a polygonal piece as in *D. filum* Clpd., but coalesce. The posterior pair of maxillary pieces are denticulated at base, but the number of teeth varies from one to five. The part of this piece behind the teeth is very variable in width; it may be nearly double the width shown in figure, and shorter. The second pair of jaw pieces have a peculiar form. Outer margin nearly straight, except in front, where it suddenly curves outward. The first tooth is long, the second quite short, the others of varying length as shown in the figure. The paragnathi or anterior small pieces, are of the same form, the anterior pair a little smaller than the posterior; each consists of a single sharp curved tooth, with two strong curved supporting branches at base.

The lower jaw pieces are extremely variable, both as to form and number; usually their length is about double their greatest width, but their greatest width may be in any part; the opposite pieces are never alike, often one is very minute; sometimes there is but one, sometimes none.

Body: general appearance same as LUMBRICONEREIS. Often a few of the posterior segments have no appendages. Anal cirri four, short. Length variable. One not particularly long specimen had 600 segments, with a length of 23$^{cent.}$; diameter 0, 6^{mm}.

Abundant at low water; mud and sandy mud.

LUMBRICONEREIS (*Bl.*) *Ehlers.*

LUMBRICONEREIS TENUIS *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 594, and p. 342.

Sea Beach. Hog Island.

ARABELLA (*Grube*) *Ehlers.*

EHLERS. Borstenwürmer, p. 398.

ARABELLA OPALINA *Verrill.*

Lumbriconereis splendida LEIDY. Mar. Inv. Fauna R. I. and N. J., p. 10.
" *opalina* VERRILL. Invert. An. of Vin. Sound, etc., p. 594, pl. xiii, figs. 69, 70; also p. 342.

Very common at low water; also dredged frequently. I have received from Prof. Verrill advance sheets of a check list of Marine Invertebrata of New England, in which the generic position of this species is rectified as above.

STAUROCEPHALUS (*Grube*) *Ehlers.*

STAUROCEPHALUS PALLIDUS *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 595 and p. 348.

Through the kindness of Prof. Verrill, I have been able to compare my specimens with those found by him in the Sound near New Haven. This species is rare in Virginia. I found only five during the entire season. They differ from the Sound specimens only in being narrower; specimens nearly as long as the type forms not being more than 1^{mm} in diameter. The length (50^{mm}) given by Verrill (l. c. p. 596) is not correct. In alcohol the longest of the two original specimens, has a length of 15^{mm}. The antennæ are longer than the head; composed, when perfect, of 12 articles. The palpi (lateral or anterior antennæ) have a stout cylindrical basal part, forming about three-fourths of their entire length, and a terminal fusiform article, separated from the basal part by a deep constriction; they are shorter than the antennæ, but longer than the head. The head is somewhat elongated, more so than in the following species. Eyes small, orange-yellow, the front pair largest. In living specimens the constriction between the basal and terminal parts of the dorsal cirri is very indistinct; in alcoholic specimens it is sufficiently well marked.

The ventral cirri arise at the outer third of foot; at first not extending beyond the foot, but further back, becoming longer, they reach a little beyond the foot.

The upper anal cirri are filiform, composed of 6–8 slender elongated articles. Their length is about that of the last six segments.

The lower cirri are cylindrical, and of the length of the basal article of upper cirri.

The color of my specimens was a uniform yellowish-white. Feet white.

Length, 14^{mm}; diameter, 1^{mm}.

Found on shells, etc. Dredged, 4–12 fathoms.

STAUROCEPHALUS SOCIABILIS *n. sp.*

PL. VII, FIGS. 89, 90, 91.

Head short, the width less than that of the first segment, convex above and below, bluntly rounded in front.

Palpi large, stout, concave below, convex above, margins crenulated; origin visible from below. Externally they taper slightly, and are longer than the head.

Antennæ, longer than palpi, diameter at base about half that of palpi, subulate, composed of 6–10 articles which are quite variable in form. On the inner half the line of division between the articles is indistinct; outer half, distinct. The terminal article is elongate, fusiform.

Eyes circular, dark red, anterior pair very large, situated between the bases of the palpi and antennæ; posterior pair small, just behind and within the bases of the antennæ.

Feet cylindrical, divided at end into upper and lower lips; upper lip further divided into anterior and posterior lobes, all three terminations somewhat flattened, triangular; lower lip slightly largest. In the posterior half of the body the length of the feet equals the width of the segments; not quite so long in front.

Dorsal cirri, longer than feet: none on first setigerous segment; first shorter than second. Base cylindrical; appendix conical or fusiform, tapers rapidly to a pointed extremity, forms about one-third the entire length of cirrus. Constriction between the base and the terminal article very deep. Blood vessels and seta very apparent in the cirrus.

Ventral cirri, arising at middle line of the foot, do not reach quite to the end of the foot.

Anal cirri: upper made up of four articles, subulate; lower, one article, similar in all respects to basal article of upper cirri.

Body, widest at anterior third, diminishing slightly in front, and more rapidly behind. Convex above, flat below; segmentation well marked.

Setæ: the terminal article of the compound setæ is much shorter and stouter than in *S. pallidus* Verr.; fig. 90 represents a form occasionally seen in the anterior feet. Simple setæ of the upper bundle long, delicate, with one edge minutely denticulated.

Color, yellowish-white; between the segments a narrow red line; a similar line crosses each segment, sometimes falling a little short of the base of the feet. Just outside of each posterior eye is a crescentic red line bounding a clear white spot; while just back of each posterior eye is an irregularly curved red line, also limiting a clear white spot. Anal segment with a quadrangular clear white spot.

Length of a large specimen, 20^{mm}; diameter, 2^{mm}.

Numerous, of all lengths from 4 to 20^{mm}. On shells, etc. Dredged.

Fam. GLYCERIDÆ.

RHYNCHOBOLUS *Clpd.*

RHYNCHOBOLUS AMERICANUS *Verrill.*

Glycera Americana LEIDY. Mar. Invert. Fauna R. I. & N. J., p. 15, pl. xi, figs. 49, 50.
" " EHLERS. Borstenwürmer, p. 668, pl. xxiii, figs. 43–46.
" " GRUBE. Jahres-Bericht der Schles. Gesell. für vaterlän. Cultur, p. 64. 1869.
Rhynchobolus Americanus VERR. Invert. An. Vin. Sound, p. 596 pl, x. figs. 45, 46.

Common. Low water and dredgings.

RHYNCHOBOLUS DIBRANCHIATUS *Verrill.*

Glycera dibranchiata EHLERS. Op. cit., p. 670, pl. xxiv, figs. 1, 10–28.
" " GRUBE. Op. cit., p. 64. 1869.
Rhynchobolus dibranchiatus VERRILL. Op. cit., p. 596, pl. x, figs. 43, 44.

Fam. CHLORÆMIDÆ.

TROPHONIA (*M. Ed.*) *Clpd.*

TROPHONIA ARENOSA *n. sp.*

PL. VII, FIGS. 92–97.

Body elongated, widest at about the 22d segment, tapering gradually in both directions; in front nearly quadrangular, the sides being straight, and the dorsal and ventral surface but slightly convex; after the first 10–12 segments the body is rounded.

Branchiæ very numerous, filiform, red at base, green externally; the inferior shorter than the superior.

Setæ of the first five segments turned forward; elongated, those of the first three reaching far beyond the branchiæ. Tentacles not quite as long as the branchiæ, canaliculated, margins scolloped; color reddish-brown with a green centre. Body above and below with numerous cylindrical papillæ, of which, in adult specimens there are five longitudinal series — one median, with two on each side equally distant from each other. The same number and arrangement holds for the ventral surface. On the anterior segments these papillæ are situated near the anterior margin, and besides those in regular series are numerous smaller ones which project forward from the front of the segments. On young specimens there may be but three series of papillæ.

The pedal rami are far removed from each other. They are surrounded by papillæ similar in all respects to those on the body, in number from 4 to 8. Back of each fascicle of setæ is an elongated cirrus (or papilla) slightly swollen at base; this is somewhat larger and longer in the dorsal than in the ventral rami.

Setæ. The dorsal setæ are all similar to f. 95, save that those of the first five segments and particularly of the first three are very long. The ventral setæ of the first three segments are like the dorsal. On the fourth segment minute terminal hooks appear with a straight tooth below. They shorten backward and the hooks enlarge as in figs. 96 and 97. Dorsal setæ amber-yellow; ventral setæ, at base dark reddish-brown, becoming lighter externally.

Body covered with fine sand, closely adherent.

Fam. CHÆTOPTERIDÆ.

SPIOCHÆTOPTERUS (*Sars*). Char. emend.

Sars, in his diagnosis of this genus, limits the segments of the middle region of the body to two. The following species agrees so closely with SPIOCHÆTOPTERUS in most respects, that it seems undesirable to form a new genus for it; the middle region, however, is composed of 20–23 segments. Sars also makes the absence of eyes a generic character; but the presence or absence of eyes seems, at least among annelids, never to have more than a specific value.

SPIOCHÆTOPTERUS OCULATUS *n. sp.*

PL. VIII, FIGS. 98–102.

Anterior region composed of the buccal segment and nine setigerous segments. Middle region, 20–23 segments.

Posterior region, segments numerous, number variable.

Head (f. 98), sunk in buccal segment and prolonged backward between the bases of the tentacles. The anterior part is trapezoidal, a little wider behind than in front; the posterior narrow part has slightly concave lateral and posterior margins, giving rounded, projecting, posterior angles. The greatest width of the head is a trifle less than its length; it is slightly convex. In front it is truncated, or bent directly downward, its front face being somewhat triangular, bluntly rounded at the apex, below.

Buccal segment, forms the anterior part of the body, projecting a little in front of the head; truncate in front, anterior margin thick, rounded; lower and lateral surfaces convex; anterior truncated face concave.

Tentacles, have the usual origin and structure, length $20\text{–}25^{mm}$.

Eyes two, lateral, just in front of the bases of the tentacles, elliptical, directed obliquely toward the middle line of the head, black.

Anterior region. The feet are flattened, fleshy lobes, thick at base, running out to a thin edge; they are dorsal, transverse, directed upward and a little outward. The setæ arise from the front face of the feet, are long internally, growing progressively shorter externally. The outer setæ do not project beyond the foot. The setæ also change their form from within outward, as shown in f. 101, a, b, c, d. The peculiar broad seta of the 4th setig. segment is slightly convex, has regular transverse markings, widens near the end. The expanded portion is thickened along an irregular line which divides it into two nearly equal parts; its outer margin obliquely truncated, thin, minutely denticulated. The remaining setæ of this segment are of the same form as those found on the other segments.

Middle region. Dorsal ramus, composed of two ventral plates, of which the inner is bilobed, and arises just outside the middle line of the dorsum (f. 99). This plate is connected at base with a similar vertical lateral plate, which, however, is not lobed, and does not contain setæ. The lips of the ventral ramus are anterior and posterior; both are connected with the latero-dorsal plate by a basal membranous prolongation. The posterior lip is a low, arched plate, running downward nearly to the middle line of the ventral surface. The anterior lip is much shorter than the posterior, arising just above and in front of the latter, also a little in front of the latero-dorsal plate. Both lips of the ventral ramus have a yellow color derived from the uncini concealed within them.

Posterior Region. The dorsal rami are vertical (f. 100), swollen at base, otherwise cylindrical, terminating in a button. They are close to the middle line of the body, and contain from four to six very delicate setæ, which project slightly. The ventral rami are the same as in the middle region, only the lips are much reduced in size, and very close to each other.

The anal segment is without appendages, conical, obliquely truncated from above downward, divided below into lobes which can not be seen from above.

Dorsal sulcus, bordered on each side by a delicate raised membrane. These may be revolute, leaving the sulcus open; or their edges may be brought together, completely closing it. Sulcus densely ciliated.

The body tapers uniformly, the diameter of the anal segment being about one-third that of the anterior part.

Anterior region, convex below and laterally; flat or slightly concave above. Middle and posterior regions rounded.

Color. The anterior region is white above; the first six segments are white below, with numerous brown specks, which often run together, forming blotches, which may occupy more space than the white; remaining segments of this region white. Sometimes the 5th or 6th segment is brownish-purple below, in which case the following one, two, or three segments are flake-white. Middle and posterior regions yellowish-white above; white to light brown below. Between the segments of the last region there is a narrow brown band running down the sides.

Tube. In front white, shining, transparent; further back yellowish-white or brown, sometimes transparent, sometimes opaque. It is annulated with raised bands, which may be black, or white, or of the color of the tube; its diameter 1^{mm}.

Length of animal, $30–50^{mm}$.

Diameter of anterior third, $0.5–0.8^{mm}$.

Found in sand at low water; only in one place, but there abundant.

Fam. SPIONIDÆ.

NERINE *Johnston.*

Nerine heteropoda *n. sp.*

PL. VIII, FIGS. 103-110.

Head, posterior two-thirds rounded (f. 103), swollen; anterior third suddenly acuminate, conical. Separation between head and buccal segment distinct. Buccal segment nearly as long as the next four segments together. The long tentacles arise at the posterior lateral margins of this segment; between their bases are four small black eyes, two on each side, all on the same straight line. Just back of the origin of the tentacles are two fans of setæ, shorter than those on the next segment, but otherwise similar to them. Each fan has a little rounded lobe back of it. These lobes are close together, similar to each other and to the ventral lobes generally, but smaller. The second segment bears a pair of short branchiæ, which increase in length on the following segments, till they nearly touch each other across the back. The anterior branchiæ bear a foliaceous lobe, with a short, free, rounded extremity (f. 104). This lobe is at first divided into two by an incision reaching nearly to the branchia; the lower lobe being double the length of the upper one. Further back the incision disappears, while the free portion of the lobe becomes longer and pointed (f. 105).

Ventral rami. On the anterior feet the ventral ramus is a rounded lobe of the same structure as the branchial lobe. At about the 25th segment, this lobe is nearly divided into two by a deep incision (f. 106); further back this division becomes complete (f. 107) leaving a squarish lobe between the dorsal and ventral rami, not attached to either. The setæ project in front of the lower lobe. On the anterior feet the dorsal setæ fall a little short of the outer margin of the lobe; afterwards they project slightly beyond it. They are numerous, arranged in a fan, delicate, bilimbate, the margins being very narrow. The anterior ventral setæ are like the dorsal (f. 108). At about the 25th segment a few bidentate setæ, with a broad membrane extending about one-third of their length, replace some of the double-margined setæ of the ventral ramus (f. 109). Still further back the bilimbate setæ disappear entirely from the lower ramus, being replaced by narrower setæ with a single margin (f. 110).

Description and figures from alcoholic specimens. Posterior segments not seen. Segments remaining, 40.

Length, 20^{mm}; diameter, 15^{mm}.

POLYDORA *Bosc.*

POLYDORA HAMATA *n. sp.*

PL. VIII, FIGS. 111-116. PL. IX, FIGS. 117,118.

Head emarginate in front, outer angles rounded, directed outward and forward.

Eyes four, black, between bases of tentacles; the anterior pair larger and further apart than the posterior.

Branchiæ begin on the seventh segment, 38 pairs, short, flattened, not tapering; bluntly rounded, almost truncate externally.

There is no terminal sucker, but in its place are two somewhat quadrangular lobes (f. 118), each with a short lateral cirrus. Anal opening surrounded by a circle of low papillæ.

Setæ. On the anterior segments are the ordinary capillary setæ, simple acuminate (f. 111); after the change of setæ, these are confined to the dorsal rami. On the fifth segment there are two kinds of setæ; in the upper series from 8 to 10 stout, flattened setæ, slightly curved near the end, not differing much from each other but with no two exactly alike (f. 112); in the lower series from 4 to 6 short capillary setæ, for the most part like f. 111, but sometimes, as in f. 113, widened at outer third.

From 15 to 24 of the posterior segments are furnished with stout hooks, one to each dorsal ramus (f. 116); with these, in addition to the ordinary capillary setæ, is one much longer than the rest (f. 117). The change of ventral setæ takes place on the 7th segment, though a few capillary setæ are found on that segment. The anterior ventral setæ (f. 114) after the change, are somewhat stouter than the posterior (f. 115), all bidentate, covered at the end with a membrane, as shown in the figures.

The anterior part of the body is rounded below and laterally, flattened above; the posterior third is thin, flattened both above and below.

Color: first third white; middle third brown, semi-transparent; last third white; or the anterior third may be light flesh color, posterior two-thirds yellowish; branchiæ red.

Found occupying tortuous galleries in compact bivalve shells. In some respects this form agrees with *P. hoplura* Clpd., but is not identical with it.

POLYDORA CÆCA *n. sp.*

PLATE IX, FIGS. 119–122.

Head emarginate in front; lateral lobes bluntly rounded, short, no eyes. A rounded carination extends from the head to the anterior margin of the 4th segment.

Tentacles, mere threads; in extension from 10 to 12^{mm} long, white, canaliculated; margins of channel flake-white, interrupted by thirteen transverse dark purple lines, which reach about half-way around the tentacles. Length of markings to spaces included between them about as 1 to 3.

First segment with dorsal ramus only; ramus small and with shorter setæ than those of the following segments.

Second, third and fourth segments with short, blunt, finger-shaped dorsal and ventral cirri.

Branchiæ begin on 7th segment, are of the ordinary form, but very numerous, existing on over 100 segments. The last three are very short, and are followed by sixteen segments without branchiæ.

Terminal sucker funnel-shaped, interrupted below; anal opening with crenulated margin.

Setæ. Very numerous in anterior dorsal rami; some very long, at least one-half longer than the branchiæ. These long setæ for the most part have the form shown in f. 119, but some are narrower. In the upper part of the bundle are shorter setæ (f. 120).

The stout setæ of the 5th segment are bluntly rounded externally, either straight, or slightly curved at tip (f. 121). Three or four short flat capillary setæ curve around the anterior margin of the first stout setæ, and lie directly across them.

Ventral setæ; from the 7th segment stout, bidentate; lower tooth much longer than upper (f. 122), and covered by membrane. They barely project from the surface; are curved within the body.

Color. Anterior part flesh-color passing into white behind.

A single specimen was found living in a tortuous gallery, excavated in a perfectly sound upper valve of *Anomia glabra* Verr. The gallery was lined by a membrane, which formed a tube projecting about 4^{mm} beyond the surface of the shell. The channels in the tentacles were densely covered with cilia. The long tentacles were almost constantly protracted and moved about. The cilia of the branchiæ were very long and numerous.

Length, 19^{mm}; diameter, in front, 1^{mm}; behind, 0.5^{mm}.

This species can readily be distinguished from any previously described from our coast by the purple markings on the tentacles. Though living in a gallery in a hard shell, it lacks the dorsal hooks of *P. hamata* and *P. hoplura* Clpd.

Fam. ARICIIDÆ.

ARICIA (*Sav.*) *Aud. & Ed.*

ARICIA RUBRA *n. sp.*

PL. IX, FIGS. 123-126.

Branchiæ beginning on the 6th setigerous segment.

Head elongate, conical, pointed, as long as the first three segments, having neither eyes, nor antennæ.

Branchiæ: on the anterior segments nearly cylindrical for the basal three-fourths, becoming suddenly conical externally. They gradually increase in length, and become flattened, triangular, but the outer fourth or fifth remains pointed, conical; on a few of the last segments they again become shorter.

The dorsal rami consist of a delicate finger-shaped dorsal cirrus, shorter than the branchiæ. From a depression at the base of this cirrus a bundle of long simple setæ arises. Further back the dorsal cirri became as long as the branchiæ, and have nearly the same form.

The ventral rami, on the first 25–29 segments, consist of two transverse membranous lips, of which the anterior is very low, hardly perceptible; the posterior a well marked plate, not reaching as far as the setæ, and with a smooth rounded margin. Between these lips are four rows of stout blunt setæ, straight or slightly curved (f. 123). These setæ are all short, first series shortest, increasing progressively in length from first to fourth series. Between the third and fourth series in the upper part of the ramus are a few, usually two, long simple capillary setæ (figs. 124, 125). The ventral rami are short on the first segment, increasing in length from the first to the sixth or seventh segment. At this point they extend from the dorsal to the ventral surface, never encroaching on the ventral surface. The last seven or eight of this series of rami decrease in length progressively, so that the last (25th–29th) is about the same length as the first, and contains about the same number of setæ. The margin of the posterior lip of the last three rami is prolonged into a delicate cirrus.

With the change of setæ the anterior lip disappears; the posterior lip becomes conical, truncated, bearing a cirrus-like prolongation on its lower outer border (f. 126), and its position is changed to the lateral margin of the dorsum.

Between the 40th and 50th feet the dorsal cirri come to be nearly as long as the branchiæ, and of the same form. With the transfer of the ventral rami to the dorsal surface the feet and branchiæ become connected by an elevated transverse membranous ridge. The dorsal and ventral setæ are alike. The dorsal cirrus stands back of the bundle of setæ which continues to arise at its base, while the ventral setæ arise from the summit and anterior face of the ventral ramus. All the setæ are very long. Throughout most of its length the diameter of the body is uniform. There is a somewhat rapid diminution in the first four segments; and a gradual diminution in the posterior fourth; the last segment having about one-half the width of the middle segments. The anterior segments are slightly concave above (f. 125), slightly convex below; posterior segments (f. 126) flat, or very slightly convex above, broadly rounded at the sides and below, with a distinct median ventral depression.

Anal cirri, four, delicate, subulate, white; the superior of the length of the last five segments; the inferior, short.

Color, red, shade varying in different individuals; middle third sometimes green.

Segments short, numerous.

Length usually about 70^{mm}, with a diameter of 1^{mm}.

Low water, mud and sandy mud.

ARICIDEA *n. gen.*

One antenna. Feet biramous. Dorsal rami with cirri; ventral rami with cirri on anterior segments only. Branchiæ on anterior segments only. Setæ all simple, capillary. First segment with setæ, no tentacular cirri.

ARICIDEA FRAGILIS *n. sp.*

PL. IX, FIGS. 127–132.

Head, posterior half convex, sides rounded; anterior half just in front of the single antenna suddenly depressed and narrowed. In contraction this anterior part is about equal in length to the posterior (f. 127) and is somewhat shovel-shaped; in extension it is double this length and is acute, conical. A very shallow incision at the end can be seen in alcoholic specimens; this was not noticed in living forms.

Eyes two, small, circular, lateral, posterior.

Antenna, arises about the centre of the head, delicate, subulate, in length not quite half the head.

Dorsal ramus with dorsal cirrus but without proper feet or ramus. Cirrus on first segment a mere papilla, increasing in length to the fourth segment, where it is about one-third the length of the branchiæ; the first three are cylindrical; the fourth, and all back of it, on the branchiated segments, have a small lobe, developed near the base, looking outward. On the non-branchiated posterior segments this cirrus loses the lobe, becomes somewhat elongated, very delicate, subulate.

Ventral ramus, on first segment a minute cylindrical papilla, a little longer than the dorsal cirrus; increasing slightly in length to the fourth segment, where it is about one-half as long as the dorsal cirrus. Back of the fourth segment it is flattened (compressed) and becomes a fleshy lobe, rounded externally. It retains this form to about the 30th segment, where it again assumes the form of a cirrus, shortens progressively, and disappears at about the 40th segment, after which segment the ventral rami are entirely without appendages. The ventral cirri are always just back of the ventral setæ.

Branchiæ, begin on fourth segment, arise just within the dorsal cirri, taper slightly to near the end when they became suddenly acuminate; they are usually directed inward and a little upward, their length being a little more than half the width of the body, so that they cross each other. The first two or three are a little shorter than those following them. They exist on 50 to 55 segments, the last two or three having about the same length as the first. After the first few segments they entirely cover the back.

The anterior dorsal setæ form a fascicle just in front of the dorsal cirrus, they are very long, (f. 131), regularly acuminate. In each bundle there are two or three in the upper part double the length of the one figured. Back of the branchiated segments, there are only four to eight in each bundle, which are a little shorter and more delicate than the anterior setæ.

Ventral setæ (f. 132, a, b.), arranged in three transverse series, numerous, inner third or half of uniform width, then suddenly acuminate, capillary termination very long and delicate. In the upper part of each ramus are a few setæ double the length of those figured; back of the branchiæ they form two fan-like series.

On the anterior branchiated segments, the dorsal and ventral surfaces of the body are very slightly convex. Their convexity progressively increases (f. 129) backwards; the sides are rounded (f. 128). On the non-branchiated segments, the lateral and ventral surfaces are regularly rounded, but there is a sudden contraction of the dorsum just above the dorsal rami (f. 130). Posterior segments not found.

A fragment 32^{mm} in length had 170 segments, and was 2^{mm} in diameter.

Color: the head is white; first 30–40 segments bright red, passing into white, which further back passes into a green. Anterior dorsal setæ, amber-yellow; anterior ventral, brownish-yellow; all setæ back of branchiæ gleaming white.

Rare; low water, mud.

ANTHOSTOMA *Schmarda.*

ANTHOSTOMA ROBUSTUM *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 597, pl. xiv, f. 76.

One specimen, much injured, but probably referable to this species.

ANTHOSTOMA FRAGILE *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 598.

A single injured specimen.

Fam. CIRRATULIDÆ.

CIRRATULUS *Lamarck.*

CIRRATULUS GRANDIS *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 606, pl. xv, figs. 80, 81.

Common both in sand and mud, low water.

Fam. CAPITELLIDÆ.

ANCISTRIA *Quatrefages.*

ANCISTRIA MINIMA *Quatr.*

Hist. Nat. des Ann., vol. ii, p. 252, pl. xi, figs. 28–34.

Claparède remarks that ANCISTRIA *Quatr.* is founded on a CAPITELLA. I know very little indeed about this group, bnt am certain that my specimens belong to ANCISTRIA as defined by Quatrefages and have found it impossible to separate them from *A. minima.*

Fam. MALDANIDÆ.

CLYMENELLA *Verrill.*

CLYMENELLA TORQUATA *Verrill.*

Clymenella torquata VERR. Invert. An. Vin. Sound, etc., p. 608, pl. xiv, figs. 71–73.

Clymene torquatus LEIDY. Marine Invert. Fauna R. I. & N. J., p. 14.

Low water, sandy mud; common.

MALDANE (*Gr.*) *Mgrn.*

MALDANE ELONGATA *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 609.

Common in mud and sandy mud, near low water mark.

Fam. AMMOCHARIDÆ.

AMMOCHARES *Grube.*

Only one specimen belonging to this genus was found, and that having only a few anterior segments, not sufficient for identification.

Fam. HERMELLIDÆ.

SABELLARIA *Lam.*

SABELLARIA VARIANS *n. sp.*

PL. IX, FIGS. 133–136. PL. X, FIGS. 137–139.

Body stout, diameter decreasing regularly from the first segment. Operculum surrounded at base by a series of conical papillæ. On the dorsal surface the inner papilla on each side is flattened at base, and between it and the operculum are a few golden setæ, curved to follow the outline of the opercular base.

The tentacles have the usual structure, are white, with sometimes a red or purple tinge.

First segment not visible above, represented below by two rounded lobes and two setigerous processes or ventral rami. The lobes are placed one on each side of the mouth; outer margin convex, inner margin concave. In life they are continually in motion, being alternately straightened or moved from the mouth, and curved inward to the mouth. Just outside of these lobes is a conical process, arising from a swollen irregularly shaped base. On the outer surface of the base is a curved depression, from which a series of setæ arises, similar to f. 139, but with the lateral appendages much longer than in that figure. The setæ and the process itself point downward.

The second segment bears branchiæ and laterally an acutely conical process with a flattened triangular base; a bundle of setæ, similar to those of the first segment, arises from the lower margin of this process near its base. There are no other setæ on this segment. Accordingly, the first two segments are uniramous having only the ventral rami and setæ. The pedal ramus of the second segment is very close to the setigerous lobe of the first, being on the antero-lateral margin of its own segment. Without careful examination it would seem that both rami belonged to the first segment.

The dorsal setæ of the third segment (f. 136) are smaller, but do not differ otherwise from those of the fourth and fifth (f. 137). Those following the fifth segment have four sharp teeth increasing progressively in length (f. 138). Branchiæ, about twenty pairs; sixth or seventh largest, growing smaller gradually, the last being quite short. Length of anterior branchiæ a little more than the width of the body.

Color: opercular lobes white with dark brown specks; first three or four segments black laterally sometimes ventrally; body generally white, often with a greenish tinge: branchiæ white or red with green centre: caudal appendage green: feet generally white, with sometimes the outer border of the posterior dorsal rami black. In a well marked color variety, the first four segments were entirely black; body green with brown spots; middle third, ventral surface, dark brownish-red; feet light green at base, passing into dark brown externally.

Length, from 8 to 18^{mm}.

The tubes of this species were numerous on shells, etc., dredged from four to twelve fathoms.

Fam. AMPHICTENIDÆ.

PECTINARIA *Lam.*

(Subgenus LAGIS *Mgrn.*)

PECTINARIA (LAGIS) DUBIA *n. sp.*

PL. X, FIGS. 140–144.

Two specimens were found which seem to belong to Malmgren's genus or subgenus LAGIS. Through some carelessness I failed to make notes on them when they were collected. Their present condition does not admit of specific description, except as regards the setæ. These, in some respects are peculiar; there are eight paleolæ on each side, flattened, slightly curved to near the end, terminating in a stout hook (f. 140). The dorsal setæ are of two forms: one, simple, acuminate (f. 141); the other, also simple, but curved slightly, and with a large, well defined projection or knee at about the outer fourth (f. 142), beyond which the edge is divided into numerous fine, hair-like, projections by oblique incisions. Ventral uncini (f. 143) with seven long, sharp teeth.

Spinulæ of the scapha (setæ of the caudal process) in two series, ten in each; of which seven are of the form a, b, f. 144, and three correspond to c, d, e.

Length of one specimen 6^{mm}; of the other 4^{mm}.

Fam. AMPHARETIDÆ.

MELINNA *Mgrn.*

MELINNA MACULATA *n. sp.*

PLATE X, FIGS. 145–147.

Branchiæ green with red centre, and narrow transverse white bands. Tentacles not much longer than branchiæ, light flesh-color.

Body flesh-color, sometimes tinged with green and with numerous flake-white specks on the anterior dorsal surface, nine or ten posterior segments dark brown to black. Eighteen anterior segments, with capillary setæ; posterior segments, 55. There is a narrow raised ventral band between the bases of the opposite feet on the first 17 setigerous segments. The first three setigerous segments have a narrow white band on which the setæ stand, running down the sides, becoming wider and rounded in front.

The spinulæ are slightly convex, strongly striated transversely; longitudinal striæ interrupted by the transverse; of uniform width to near the end, when they curve suddenly, ending in a sharp point (f. 147).

Capillary setæ bilimbate; one margin very narrow and shorter than the other (f. 146). Uncini with four long sharp teeth, and one short tooth (f. 145).

This species is certainly closely related to *Sabellides* (*Melinna* Mgrn.) *cristata* Sars, but probably not the same. It will be seen that the uncini agree with those figured by Sars (*Fauna littoralis Norvegiæ*, pl. ii, figs. 6, 7), except that they have an additional tooth. The spinulæ are also very much alike (compare f. 147 with Sars l. c. pl. ii, f. 5).

Malmgren has figured the same parts (*Nord. Hafs-Ann.*, pl. xx, figs. 50 D, 50 C), but his figures differ so much from those given by Sars that it hardly seems probable they were made from the same species.

Fam. TEREBELLIDÆ.

AMPHITRITE (*Müller*) *Mgrn.*

Amphitrite ornata *Verrill.*

Terebella ornata Leidy. Marine Invert. Fauna. R. I. and N. J., p. 14, pl. xi, figs. 44, 45.

Amphitrite ornata Verr. Invert. An. Vin. Sound, etc., p. 613, pl. xvi, f. 82.

Very common in mud and sandy mud, at low water.

SCIONOPSIS *Verrill.*

Scionopsis palmata *Verr.*

Invert. Animals of Vineyard Sound, etc., p. 614.

The few examples which were found, were of small size.

PISTA *Mgrn.*

PISTA CRISTATA *Mgrn.*

MALMGREN. Nord. Hafs-Ann., p. 382, pl. xxii, f. 59.
VERRILL. Amer. Journ. Sci. Arts, Third Ser., vol. x, p. 40.

A single imperfect specimen was collected, consisting of the anterior half.

LEPRÆA *Mgrn.*

LEPRÆA RUBRA *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 615.

Common, but all of the specimens were of small size.

POLYCIRRUS (*Grube*) *Mgrn.*

POLYCIRRUS EXIMIUS *Verrill.*

Torquea eximia LEIDY. Marine Invert. Fauna R. I. & N. J., p. 14, pl. xi, figs. 51, 52.
Polycirrus eximius VERR. Invert. An. Vin. Sound, etc., p, 616, pl. xvi, f. 85.

ENOPLOBRANCHUS *Verrill.*

ENOPLOBRANCHUS SANGUINEUS *Verr.*

Chætobranchus sanguineus VERR. Invert. An. Vin. Sound, etc., p. 616.
Enoplobranchus sanguineus VERR. Check List of Marine Invert. of the Atlantic Coast from Cape Cod to the Gulf of St. Lawrence, p. 10 (advance sheets).

LYSILLA *Mgrn.*

LYSILLA ALBA *n. sp.*

PLATE X, FIG. 148.

Frontal membrane divided into five lobes by deep incisions, each lobe being scolloped or deeply folded. Cirri, long, white with colorless centre; some filiform, others enlarged and flattened in their outer third.

Body, first third swollen, then tapering uniformly but very slightly. Anterior two-thirds white, transparent; internal organs showing through. Alimentary canal surrounded, except for a short distance in front, by a yellow glandular mass which is divided on each side of the middle line into semicircular lobes or plates of varying thickness. First third may be regarded as made up of fourteen or fifteen segments, but the segmentation is very obscure. On most specimens there are peculiar bodies on thirteen segments, beginning with the second, appearing as lateral circular elevations with raised margin, concave, centre occupied by a minute elevated point. I know nothing as to the function of these bodies which are not found on some specimens. No segmentation could be made out along the middle third of fresh specimens. In alcoholic specimens, on the ventral surface, lines of division can be seen, but they are very obscure. The posterior third is light gray, with brown specks, opaque, and terminates in a clear white anal segment.

Segments clearly defined, short, numerous. The anal aperture has a minutely crenulated margin.

The entire body is covered with narrow, raised transverse lines, made up of minute verruciform bodies; these are less apparent on the middle third than elsewhere. In living specimens a narrow, raised, flattened band occupies the middle line of the ventral surface. In alcoholic specimens the ventral surface is much depressed, and an elevated rounded ridge on each side separates it from the lateral surface.

Setæ. After careful examination of many specimens I believed that this species was without setæ. Afterwards I found a single fascicle of six setæ, one of which is represented in f. 148. Malmgren assigns to Lysilla six setigerous segments. I am unable to say how many segments of this species are setigerous, but have referred it to Lysilla because in all other respects it agrees with that genus.

Fam. SABELLIDÆ.

SABELLA (*L.*) *Mgrn.*

SABELLA MICROPHTHALMA *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 618.

POTAMILLA *Mgrn.*

POTAMILLA TORTUOSA *n. sp.*

PLATE X, FIGS. 149–153.

Branchiæ, six pairs, colorless, transparent, with transverse markings of brown and white, and a green centre, connected at base for a short distance by a membrane. Pinnæ often with same markings as stem. The first pair (dorsal) of branchiæ are without eyes. The 2d, 3d, and 4th may have from one to three convex dark red eyes, which are placed at equal distances from each other, the outer one being about half-way out on the stem; their transverse diameter equals the width of the stem; longitudinal diameter a little longer than the transverse. Fifth and sixth pairs of branchiæ without eyes.

The ventral sulcus is continued on the dorsum, but is hardly perceptible save on the first three segments. Anterior part of body usually composed of eight segments, but may have seven, eight or nine. Each of these segments has its ventral surface divided into two equal parts by a transverse impressed line. Back of these the ventral sulcus divides the ventral surface of each segment into lateral quadrangles, whose length is double their width in front; the length becoming less as the segments shorten, they finally become squares. The tentacles are flattened, triangular at base, becoming subulate further out; length, about one-third that of the superior branchiæ.

Pinnæ long, densely ciliated.

All the setæ of the first segment are capillary, similar to f. 149, but with narrower margin. The manubrium of the anterior uncini is very long (f. 152). The short capillary setæ of the anterior segments (f. 150), evidently agree better with LAONOME than with POTAMILLA. The ordinary form of capillary setæ on the posterior segments is shown in f. 153, but there are a few with narrower margins, and also some with a single margin, similar to f. 149. Body of nearly uniform size, a few of the last segments tapering slightly.

This species lives in tortuous galleries excavated in compact shells, lined with a delicate membrane, which projects from 6 to 10^{mm}. No entire specimen was obtained. They could not be withdrawn without breaking, and it was difficult to follow the galleries, owing to their tortuous course and to the compactness of the shells.

A nearly entire specimen, having 100 segments, was 15^{mm} in length; width not quite 1^{mm}. Color, reddish-brown above, white below.

This species lives in colonies, and scattered among them were frequently found individuals with only three pairs of branchiæ, light red, without eyes, quite short and narrow. As in all other respects they agree perfectly with the species described above, they may be the young of that form.

I have referred this species to POTAMILLA *Mgrn.*, although it does not agree with that genus in all respects. The ventral sulcus is certainly continued on the dorsum. The form of the shorter capillary setæ has been already referred to. Aside from these points it agrees with POTAMILLA.

Fam. SERPULIDÆ.

HYDROIDES *Gunnerus.*

HYDROIDES DIANTHUS *Verrill.*

Serpula dianthus VERR. Invert. An. Vin. Sound, etc., p. 620.
Hydroides dianthus VERR. In Notes on the Nat. Hist. of Fort Macon, N C., Coues and Yarrow (No. 5), in Proc. Acad. Nat. Sci. Phila., 1878 (advance sheets).

GENERA INCERTÆ SEDIS.

CABIRA *n. gen.*

Sides of head produced into thin plates, which are covered with papillæ. First segment with two pairs of tentacular cirri, without setæ. Dorsal cirri on all segments; no ventral cirri. Ventral setæ, stout hooks beginning on the 6th setigerous segment, one to each ramus.

CABIRA INCERTA *n. sp.*

PLATE XI, FIGS. 155-157.

Head convex above and below, bluntly rounded in front, lateral margins prolonged into membranous expansions, which project in front of the head, and are densely covered with minute papillæ. Antennæ two, minute, arising from a short swollen base, lateral, situated at the anterior third (f. 154).

Buccal segment, in length about equal to the two following segments; no setæ; two minute tentacular cirri on each side; separated from the following segment by a deep lateral constriction.

Feet. Dorsal ramus with a small dorsal cirrus; similar in all respects to the antennæ and tentacular cirri; beneath this arise from two to four delicate capillary setæ (f. 157, a, b). Ventral ramus a small papilla, from the summit of which issues a strong hooked seta (f. 156). The first five setigerous segments have only the dorsal rami.

Body convex above, flat below. Posterior part not seen.

Length of part examined (40 segments), 12^{mm}.

Color, light gray.

Found living in a fragment of loosely compacted sandstone. Dredged.

PHRONIA *n. gen.*

Head divided into palpi. Body elongate, flattened, composed of numerous segments. First segment with two pairs of tentacular cirri, without setæ. Dorsal cirri of second segment similar to the upper tentacular cirri. Remaining dorsal cirri flattened, thin. Feet uniramous. Setæ all simple, capillary. Anal segment not seen.

PHRONIA TARDIGRADA *n. sp.*

PLATE XI, FIGS. 158-163.

Head (f. 158), width greater than length ; lateral margins slightly concave ; posterior margin straight to the middle third, then curving suddenly backward, encroaching on the front of the buccal segment ; on the lower surface, close to the inner anterior margin of the frontal lobes (palpi), two minute papillæ, which, pointing forward and inward, project a little beyond the palpi ; in front the division between the palpi extends about one-third of the way back ; above, is continued as a shallow depression ; below, as a deeply impressed line, to the posterior margin : palpi broadly rounded in front. Antennæ two, conical, lateral, very small.

Tentacular cirri ; superior, conical, elongate, turned forward, reaching a little beyond the head : inferior, conical, minute. Sides of the buccal segment turned forward, embracing the head. The mouth has a crenulated posterior margin. Dorsal cirri of the second segment similar to those of the first, but a little longer and very slightly flattened ; after the first they have a cylindrical or slightly tapering basal article ; back of the second segment they are suddenly shortened and flattened, becoming leaf-shaped (figs. 159, 160). The substance of these cirri is crowded with small glandular bodies, and those of the anterior segments have a series of minute cylindrical papillæ along their inner back margin. The ventral cirri originate at first near the base of the dorsal cirri (f. 159); further back that part of the basal article carrying the dorsal cirrus becomes longer, but the position of the ventral cirrus remaining unchanged (f. 162), it now falls short of the base of the dorsal cirrus. The middle third of the anterior segments is slightly convex above, otherwise the body in this region is flat both above and below; further back the outline is that shown in f. 164. The posterior setæ (f. 161) are longer and stouter than the anterior but not so numerous.

In the single specimen found there were 320 segments; the posterior portion of the body had been lost.

Length observed, 90^{mm}.

Diameter of head, 0.4^{mm}; breadth of third segment, 1.1^{mm}; of 100th segment, 4^{mm}; of 300th segment, 3.5^{mm}.

All the body measurements include the feet; and the changes in width are almost entirely due to the increase, and subsequent decrease, in the length of the feet; the width of the body changing but very little.

Color everywhere white.

Found at extreme low water in soft mud.

THE SCIENTIFIC LIFE AND WORK OF H. V. REGNAULT.

By Alexander Duane,

Special Student in Union College.

[Read before the Albany Institute, Dec. 10, 1878.]

I.

HIS LIFE.

Henri Victor Regnault was born at Aix-la-Chapelle on the 10th of July, 1810. At an early age he became an orphan, and was thrown upon his own resources to provide for himself and a sister. Finding no employment in his own city, he removed to Paris and there obtained a place as shopman in a bazaar. In this humble position his inclination urged him to scientific research and through the good use of the limited means at his disposal, he became noted for his attainments in chemistry. In 1830, he passed with distinction the severe competitive examination required for admission to the Polytechnic School, and, after two years study in that institution, graduated as a mining engineer.

His attention at this time was principally directed to the study of organic chemistry. While still prosecuting his researches, he became professor at Lyons, whence he was called in 1840 to the chair of chemistry in his *alma mater*, the Polytechnic School of Paris. In the same year, his essay on the Action of Chlorine on Hydrochloric Ether appeared in the Annales de Chimie et Physique (2d series, vol. 71). This was the first of his published works which attracted much notice, but previous to this he had contributed several articles both to the Annales and to other scientific periodicals. About this time he was elected a member of the French Academy, his valuable discoveries in organic chemistry having secured for him this honor.

In 1841 he was appointed professor of physics in the college of France.

It was at this time that he began what became the great work of his life. The experiments which constitute this work were instituted at the request of the minister of public works who proposed the following problem: *To determine the principal laws and the numerical data which enter into the calculation of the work of steam engines.* To the solution of this problem Regnault devoted himself with wonderful ingenuity and patience during the interval between 1840 and 1852; and for years after the latter date, he was occupied with problems growing out of the original one.

The first installment of the results of his researches appeared in the 21st volume of the Memoirs of the Academy of Sciences. These researches, extending through a period of seven years, furnished the data for the most accurate and important of his determinations, and form his chief title to fame as a physicist. For this great work he received, in 1848, the Rumford medal, for the greatest advance made in physical science during the year.

Previous to this, in 1847, he had been made chief engineer of mines in France. His official duties, however, did not interfere with his activity in scientific matters. Not only did he continue to carry on his experiments, but he also found time to complete and publish his Cours Élémentaire de Chimie in four volumes. An abridgment of this work, entitled Premiers Élémens de Chimie, was printed two years later and translated into several European languages.

He was now at the summit of his reputation, and additional honors and duties were heaped upon him. He was made foreign member of the Royal Society of London, and corresponding member of the societies of St. Petersburgh and Berlin. From England he also received the Copely medal. In 1850, he was made officer of the

Legion of Honor. In 1855, he was appointed director of the porcelain works at Sèvres, a position which he held for eighteen years. While there he displayed his usual industry and ingenuity and many improvements in the process of porcelain manufacture are due to him. He still continued his experiments in physics, although they were much interrupted by various duties and also by a severe accident which happened to him soon after his appointment at Sèvres.

From this time his scientific work appears chiefly in communications to the Academy of Sciences and in contributions to the Annales de Chimie et Physique, of which he was for many years an editor. In this latter capacity he was associated with such men as Dumas, Wurtz, and Boussingault.

In the latter part of his life, domestic troubles came fast upon him. His sister, whom he had supported in the days of his youthful poverty, died, while on a visit at his house. Of his four children, two daughters and a son were little better than idiots, and the former, at the time of their father's death, were kept under strict guardianship. The other son, Henri, a painter of great promise, and a man of cultivated literary tastes, was killed in the battle of Buzenval in the year 1871. Regnault himself became paralytic, and it was even rumored that his mind had been affected, and that it had been found necessary to put him under restraint. This report, however, was without foundation. He attended the meetings of the Institute up to the day of his death, and although he could not walk without support and was otherwise helpless physically, his mind seems to have been perfectly clear to the end. The last four years of his life were spent at Auteuil, a place, about three miles from Paris, where Boileau, Molière and other famous Frenchmen had lived and died. He seldom left the place except to attend a meeting of the Academy, where he could still observe the progress of science in the younger generation. His own work was done, and he was soon to follow his great predecessor, Rumford, who had died in that very place many years before.

Regnault died on the 19th of January, 1878, exactly seven years from the date of his son's death, and in the sixty-eighth year of his own age. His funeral was attended by a long procession, including some of the most distinguished men of science and many of the populace, to whom he was endeared by his benevolent character. Representatives from the College of France, the School of Mines, the Academy of Sciences and the Polytechnic School, acted as pall-bearers; and addresses in behalf of each of these institutions, with all of which Regnault had been connected, were made by men who had been his associates and his pupils.

Thus passed away one of the most remarkable scientific men that France has produced during the present century. We do not propose to speak of his moral character, good and noble as it was; nor yet of those qualities by which he gained his position as the foremost experimentalist of his age; the qualities of industry, patience, rectitude of purpose, and fairness in dealing with his predecessors' work. We shall simply sketch the outline of his scientific labors, and strive to show what he accomplished towards determining the constants of thermal physics.

II.

HIS SCIENTIFIC WORK.

Regnault's most important work, as we before remarked, is found in the 21st volume of the Memoirs of the Academy. This comprises ten distinct memoirs, each of which contains either a determination of an important physical constant, or the enunciation of some new principle. Preceding these is a general discussion, in which he states the problem, assigned him by the minister of public works, in a form more suited to his own purposes. His statement is as follows: "Given a certain amount of heat, what, theoretically, is the motive power which can be obtained by applying it to the development and expansion of elastic fluids, under different conditions capable of practical realization?" This problem he shows to be reducible to that of the determination of the six following data:

(I.) The law which connects the elastic force of a vapor with the temperature.

(II.) The total quality of heat required in order to raise a kilogram of water from 0° C. to a state of vapor.

(III.) The calorific capacity of liquid water at various temperatures.

(IV.) The specific heat of aqueous vapor in different conditions of density and at different temperatures.

(V.) The law according to which the density of aqueous vapor varies under different temperatures.

(VI.) The coëfficient of expansion of aqueous vapor taken under different conditions of density.

The ten memoirs which follow are of such intrinsic importance, and exhibit so clearly the character of Regnault's scientific work, that it will be well to examine them with considerable detail.

The first memoir is on the expansion of elastic fluids. First in order are five series of experiments to determine the coëfficient of expansion of air, each series being made under different conditions and with different apparatus. The following table gives an abstract of the results obtained.

Series.	No. of Experiments in each series.	Mean value 1 + 100a.	Difference between greatest and least values in each series.
1	14	1.36623	.00140
2	18	1.36633	.00118
3	12	1.36679	.00135
4	6	1,36650	.00130
5	4	1.36706	.00025

The magnitude of the fifth determination as compared with the other four, is due not to errors in the experiments, but to the fact that the first four indicate the coëfficient of expansion of air when at constant volume, and the last indicates the coëfficient of expansion of air under constant pressure.

In the second part of the same memoir he determines the coëfficients of expansion of some other gases, and disproves the opinion, previously entertained, that all gases expand equally under the influence of heat. In the third part he proves by more than thirty experiments with various apparatus that the coëfficient of expansion increases with the pressure. He also points out that for gases in a state of extreme dilatation the coëfficient of expansion is the same in all, so that Gay-Lussac's law holds good if we understand it as applied only to gases in this limiting state.

The second memoir is on the determination of the density of gases. The values here given are considered by Roscoe (Elementary Chemistry, Appendix, p. 443), to be the most reliable of all of Regnault's determinations. Those for oxyyen and nitrogen are confirmed in a remarkable manner by the experiments of Stas on the combining weights of these elements. Regnault's researches give for oxygen a combining weight of 15.960, which is exactly the value obtained by Stas, and for nitrogen, 14.025, which is .017 in excess of Stas' determination.

The third memoir discusses experiments on the weight of a litre of air and on the density of mercury. The values which he deduced are accepted on all hands as the most reliable of any that we possess, and are quoted in all the text-books as the standard determinations for these important constants. He adds a formula by which the weight of a litre of air may be found for any latitude and any height above the sea-level.[1]

The fourth memoir treats of the measure of temperatures. In this he shows the great superiority of air-thermometers for scientific purposes. The experiments on mercurial thermometers are very complete, and in all cases include a chemical analysis of the glass envelope. He thus compared three mercurial thermometers, having differently constituted envelopes, with an air-thermometer, in a series of sixty-three experiments, and afterwards extended the comparison to other mercurial thermometers. These investigations prove that beyond the boiling point of water, the indications of the ordinary instruments exhibit errors ranging from 1° to 10° C. The following abstract of a part of his results makes this statement clear:

Air Thermometer.	Thermometer with crystal envelope.	Thermometer with ordinary envelope.
100°	100°.00	100°.00
150°	150°.40	149°.80
200°	201°.25	199°.70
250°	253°.00	250°.05
300°	305°.72	301°.08
350°	360°.50	354°.00

The same memoir also contains an extended discussion

[1] Denoting the height above the sea by h, the latitude by l, and the mean radius of the earth by R, the weight in grammes $= 1.292673 \times \dfrac{1}{1+\dfrac{2h}{R}}$ $[1 - .002837 \cos. 2l]$.

on the practicability of employing thermo-electric currents as measures of temperature, and he concludes that in the present state of our knowledge of their action, they cannot advantageously be used for that purpose.

The fifth memoir enumerates his experiments for determining the absolute expansion of mercury. These are no less than 135 in number and show conclusively that the coëfficient of expansion of this body increases with the temperature. Thus:

Between	0°	and	50°	it	is	.00018027
"	0°	"	100°	"	"	.00018153
"	0°	"	200°	"	"	.00018405
"	0°	"	300°	"	"	.00018658
"	0°	"	350°	"	"	.00018784

From these results he demonstrates that the expansion of mercury may be represented by a parabolic formula of two terms, thus: $D_T = b\ T + c\ T.^2$ He determined the values of the constants b and c to be as follows:

$$b = .000179005\ , \quad c = .0000002523.$$

The sixth memoir is on the law of compressibility of elastic fluids. This law, it had hitherto been supposed, was expressed with sufficient exactness by Mariotte's proposition, that the product of the volume by the pressure is a constant quantity. On air, Regnault made nine series of experiments, comprising sixty-six experiments in all, on nitrogen twelve series of ninety-eight experiments, on carbon dioxide, ten series of eighty experiments, and on hydrogen, eleven series of eighty-three experiments. By a comparison of these data, he proves that Mariotte's law is far from being rigorously exact. He also points out a striking peculiarity exhibited by hydrogen when under pressure. While air and other gases expand more than they should do, to be in accordance with Mariotte's law, so that the product VP increases slightly as V increases, the contrary is the case with hydrogen, and VP diminishes as V increases.

In his seventh memoir which is on the compressibility of liquids, he records experiments, which, from lack of time to perform them thoroughly, afforded no satisfactory results. His reason for giving his results, at all, is characteristic. He does not bring them up in order to found a theory upon them, but, to use his own language, "with the view of calling the attention of experimenters to this part of general physics, and with the hope that these observations may be of some use to those who may wish to make a special study of the matter."

The eighth and longest memoir is on the elastic force of vapor of water at different temperatures. The first part details the experiments made when the temperature was below 50° C. He made in this division alone fourteen series of experiments, comprising 464 separate observations. The temperatures range from −30° to + 50°, and for any one temperature there are several determinations. He paid special attention to the determination of the tension of vapor when at the freezing point, making sixty-four observations on this value alone.

Then follow four series of observations, containing 150 determinations, and comprising temperatures from 40° to 100°. The next set of observations includes three series of 94 determinations, in which the temperatures range from 100° to 140°, and six series of 232 determinations, for temperatures between 100° and 230°.

In another part of the memoir he combines this immense mass of numbers, and after constructing a curve which represents graphically the relation between temperature and tension, discusses the formulæ which have been proposed to indicate this relation algebraically. He settles on the following formula as corresponding very closely with the experimental results up to a comparatively high temperature.

$$\text{Log. F} = a - b\, m^x - c\, n^x,$$

where x = temperature in C. degrees + 20°, F = tension in millimetres, $a = 6.2640348$, log. $b = 0.1397743$, log. $c. = 0.6924351$, log. $m = \bar{1}.994049292$, log. $n = \bar{1}.998343862$.

The values given by this formula for all temperatures between − 20° and + 230° do not differ from the corresponding values derived from experiment by more than 1–400th of the whole, a difference, which, as Regnault remarks, falls within the limits of observational errors.

I have compared the results given in this memoir with those obtained from experiments, made in the physical laboratory of Union College, during February 1877, by myself and others, under the supervision of Mr. O. H. Landreth, now of Dudley Observatory. The values are in close agreement up to tensions of about two and a half atmospheres; after this the correspondence is less exact, though still quite marked. A comparison of the curves constructed from the two sets of observations shows that Regnault's curve may be regarded as the mean to which the other approximates more or less closely, the sinuosities of the latter curve lying about equally on both sides of the former.[1] It is probable, therefore, that if additional observations could be had, the curves would be

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[1] *Comparison between some of the results obtained in the laboratory at Union College and Series t of Regnault.*

Regnault.		U. C. Laboratory.	
Temperature.	Tension in mm.	Temperature.	Tension in mm.
106°.81	962.16	107°.2	960.00
115°.15	1,271.51	115°.2	1,260.00
121°.25	1,540.36	121°.4	1,560 00
126°.24	1,796.98	125°.7	1,737.20
130°.33	2,030.33	129°.3	1,936.90
135°.98	2,390.00	135°.5	2,335.50
138°.39	2,561.68	138°.0	2,538.00
143°.07	2,923.52	143°.1	2,937.60

brought to coincide. We see then that Regnault did wisely in multiplying observations so as to eliminate those slight anomalies and errors which are the bane of every experimenter in physics.

The ninth memoir contains his experiments on the latent heat of the vapor of water. For the equivalent of this he obtained as the mean of forty-four observations, the value 636.67 kilogram-degrees. This was for vapor at atmospheric pressure, but the memoir also describes seventy-three experiments to determine the latent heat when the pressure varied from 1 to 13.6 atmospheres, twenty-three experiments with pressures of .2 to .66 atmosphere, and twenty-two experiments when the range was from four to twelve millimetres. This memoir offers a direct determination of the second datum of his original problem, as the preceding memoir, accomplished the determination of the first.

The tenth and last memoir determines the specific heat of water at various temperatures by means of forty experiments, and thus fixes the third datum of the general problem.

Such are the contents of this one contribution to the science of heat, containing in itself more accurate and more abundant results than are usually afforded by the scientific labors of a life-time. These memoirs, moreover, are valuable not merely as a record of what Regnault himself accomplished, but also as containing an impartial account of all previous investigations, in the same field, including the labors of Rumford, Black, Dalton, Gay-Lussac, Dumas, Dulong, Petit and others. In treating his predecessors' work he is always fair-minded and never tries to arrogate to himself the praise due to others. He recognized the fact that truth not fame must be the object of scientific endeavor.

In this cursory review of Regnault's great work, all the details, which illustrate his patience, his ingenuity, and the great improvements which he effected in experimental apparatus, have been suppressed. It is difficult indeed for one to form a fit conception of these things, who has not read the ponderous volume in which his account is contained, nor himself endeavor to perform the experiments which are therein described. But the mere results which have been given are enough to show the value of the researches which are contained in these ten memoirs, and which occupied but seven years of his busy life.

Important as they are, these memoirs comprise only a small portion of Regnault's writings. Besides his treatise on chemistry there are a great number of contributions of his to the Annales de Chimie et Physique, and to other periodicals, as well as additional communications to the Academy, which are found in vols. 10, 26, 31, 37 of the memoirs of that body.

The importance of Regnault's scientific work can scarcely be over estimated. Much as science is indebted to the formation of hypotheses and the coördination of phenomena, it must still find its ultimate basis in the groundwork of facts. Thus theory must ever be preceded by, and founded upon, observation.

It was only by the industrious labors of a Tycho Brahe that the speculations of a Kepler could be made good, and in the same manner Regnault, in determining the data of thermal physics, has paved the way for the future discoverer of the laws of that science. He has laid a foundation on which others may build, and it is this which forms his title to gratitude from all succeeding scientists.

His entire life was devoted to the pursuit of truth, and the work which he accomplished, and no less the spirit in which he performed it, will form the best monument for himself and the best example for his successors.

APPENDIX.

Regnault's Scientific Writings.

The following list is as accurate and complete as I have been able to make it. For its construction, I have looked through all the volumes of the periodicals cited which are in the library of Union College, and have sought for every other accessible source of information. Yet I am sensible that the list is very incomplete, and only give it as a guide to those who may wish to pursue the subject further, and find out what Regnault wrote, and where his writings can be found.

On Sulpho-naphthalic Ether. L'Institut for Aug. 1837, quoted in Phil. Mag., 3d Series, vol. xi.

Metallic Pectates, Pectic Acid, Pectates of Potash, Soda and Ammonia. Journal de Pharmacie, xxiv, pp. 201, 205, quoted in Phil. Mag., 3d Series, xiii.

On Micas containing Lithia and Potash. Annales de Chimie et Physique, 2d Series, vol. —, pp. 67–72, quoted in Phil. Mag., 3d Series, xiv.

Preparation of Dichloride of Carbon. Annales de Chimie et Pharmacie, lxx, p. 105, quoted in Phil. Mag., 3d Series, xiv.

Action of Chlorine on Hydrochloric Ether. Annales de Chimie et Physique, 2d Series, vol. lxxi, quoted in Johnson's Cyclopedia and elsewhere.

First memoir on the Specific Heat of some Simple and Compound Bodies. Annales de Chimie et Physique, 2d Series, vol. lxxiii, quoted in Mémoires de l'Académie, vol. xxi, Mémoire 10.

On the Expansion of Elastic Fluids. Annales de Chimie et Physique, 3d Series, vols. iv and v. Forms body of Memoir i, of vol. xxi, Mémoires de l'Académie.

On the Comparability of Thermometers. Annales de Chimie et Physique, 3d Series, vols. v and vi, quoted in Mémoires de l'Académie, vol. xxi, Mém. iv.

Articles on Specific Heat. Annales de Chimie et Physique, 3d Series, vol. ix, quoted in Mémoires de l'Académie, vol. xxi, Mém. x, and vol. xxvi, Mém. i.

The Determination of the Weight of a litre of Air. Annales de Chimie et Physique, 3d Series, vol. ix, contained in Mémoires de l'Académie, vol. xxi, Mém. iii.

First Part of Memoir on the Elastic Force of Aqueous Vapor, Annales de Chimie et Physique, 3d Series, vol. xi, formerly part of Mémoires de l'Académie, vol. xxi, Mém. viii.

On the Compressibility of Liquids, Annales de Chimie et Physique, 3d Series, vol. xii, quoted in Mémoires de l' Académie, vol. xxi, Mém. vii.

On the Volumenomètre. Annales de Chimie et Physique, 3d Series, vol. xiv, quoted in Mémoires de l' Académie, vol. xxi, Mém. v.

On the Boiling-point of water at different elevations. Annales de Chimie et Physique, 3d Series, vol. xiv, quoted in Silliman's Journal, 2d Series.

On the Air-Pyrometer. Annales de Chimie et Physique, 3d Series, vol. xv, quoted in Mémoires de l'Académie, vol. xxvi, Mém. i.

Articles on Hygrometry. Annales de Chimie et Physique, 3d Series, vol. xv, quoted in Mémoires de l'Académie, vol. xxvi, Mém. i.

Mémoires de l' Académie, vol. xxi, pp. 1–748.

I. On the Expansion of Elastic Fluids.
II. On the Determination of the Density of Gases.
III. Determination of the Weight of a Litre of Air, and of the Density of Mercury.
IV. On the Measurement of Temperatures.
V. On the Absolute Expansion of Mercury.
VI. On the Law of the Compressibility of Elastic Fluids.
VII. On the Compressibility of Liquids and particularly of Mercury.
VIII. On the Elastic Force of Aqueous Vapor at Different Temperatures.
IX. On the Latent Heat of Aqueous Vapor at Saturation, under Different Pressures.
X. On the Specific Heat of Liquid Water at Different Temperatures.

[These memoirs are extensively quoted, translations appearing in the Phil. Mag., 3d Series, vol. xxxvi, in the Journal of the Franklin Institute, in the Cavendish Society Reprints and elsewhere.]

The Eudiometric Method. Annales de Chimie et Physique, 3d Series, vol. xxvi, quoted in Mémoires de l'Académie, vol. xxvi.

Specific Heat of Potassium, etc., Annales de Chimie et Physique, 3d Series, vol. xxvi, quoted in Silliman's Journal, 2d Series, vol. viii.

Researches on the Composition of Atmospheric Air. Annales de Chimie et Physique, 3d Series, vol. xxxvi.

Studies in Hygrometry. Annales de Chimie et Physique, 3d Series, vol. xxxvii.

Note on the Specific Heat of Red Phosphorus. Annales de Chimie et Physique, 3d Series, vol. xxxviii.

Mémoires de l'Académie, vol. xxvi, pp. 1–915.

I. On the Specific Heat of Elastic Fluids. [Appearing in the Comptes-rendus, and copied in Phil. Mag., 4th Series, vol. v, Supplement. Remarkable as containing the record of a great number of Experiments, whose results he leaves out of consideration, because the methods used were found to be not quite exact.]
II. On the Elastic Force of Saturated Vapors at Different Tempera-

tures. (Continuation of Mém. viii, of vol. xxi of the Mémoires de l'Académie.)

(1.) Elastic Forces of Saturated Vapors *in vacuo.*

(2.) Temperature of Ebullition of Saline Substances.

(3.) Elastic Force of Vapors in Gases.

(4.) Elastic Force of Vapors Emitted by Volatile Liquids Mixed by Reciprocal Solution or when Superimposed.

(5.) Researches to Determine whether the Solid or Liquid State of a Body Influences the Elastic Force of Vapors Emitted under these Different Conditions.

[Part of this memoir is quoted in Phil. Mag., 4th Series, vols. viii, ix, and xx.]

III. On the Latent Heat of Vapors under Different Pressures. (Continuation of Mem. ix, of vol. xxi of the Memoirs.)

On the Specific Heat of some Simple Bodies, and on the Isomeric Modifications of Selenium. Annales de Chimie et Physique, 3d Series, vol. xlvi, quoted in Phil. Mag. 4th Series, vol. xii, and in Silliman's Journal, 2d Series, vol. xxii.

On the Specific Heat of some Simple Bodies. Annales de Chimie et Physique, 3d Series, vol. lxiii, quoted in Silliman's Journal, 2d Series, vol. xxxiii.

Note on a Gas-thermometer, Employed as a Pyrometer for the Measurement of High Temperatures. Annales de Chimie et Physique, 3d Series, vol. lxiii.

Note on Apparatus to Determine the Density of Gases and Vapors. Annales de Chimie et Physique, 3d Series, vol. lxiii. [All the three foregoing articles are quoted in Phil. Mag., 4th Series, vol. xxiii.]

On the Determination of Temperatures and of Pressures in Aerostatic Ascensions. Annales de Chimie et Physique, 3d Series, vol. lxiv, quoted in Phil. Mag., 4th Series, vol. xxiv.

On the Specific Heat of Thallium. Annales de Chimie et Physique, 3d Series, vol. lxvii.

Note on an Apparatus for Fractional Distillation to Obtain the Market value of the Essential Oils which Originate from the Calcination of Coals or Schists. Annales de Chimie et Physique, 3d Series, vol. lxviii.

On the Velocity of the Propagation of Waves in Gaseous Media. Abstract of Memoirs in the Mémoires de l'Académie, vol. xxxvii, quoted in Phil. Mag., 4th Series, vol. xxxv.

Note on the Specific Heat of Natural and Artificial Graphites.

On the Expansion of Gases. Mémoires de l'Académie, vol. xxxi, quoted in Phil. Mag., 4th Series, vol. xxxix.

UNITED STATES SPECIES OF LYCOPERDON.

By Charles H. Peck, A.M.

[Read before the Albany Institute Feb. 4th, 1879.]

The literature of the puff-balls of the United States is very much scattered and in some instances scarcely accessible, the descriptions are often imperfect and unsatisfactory and the technical terms employed in describing the species are scarcely intelligible, without explanation, to any except mycologists. It has therefore seemed desirable to bring together the descriptions of all our species, so far as known, and, for the purpose of rendering them more satisfactory and intelligible to the general reader, to remodel them, giving them more uniformity of style and more completeness of detail and employing the strictly technical terms only after having given an explanation of their meaning. Besides this the specific descriptions have been supplemented by remarks upon the general and more obvious characters, and the distinguishing features of such species as are closely allied and liable to be confused have been specially mentioned. It is believed that the species thus described can be identified without the aid of a microscopic examination of the spores, but for the sake of completeness the spore characters have been given in all cases in which they were ascertainable. In nearly all cases the descriptions have been drawn up with the specimens before me.

The following is the generic description translated from *Fries' Systema Mycologicum* and usually given in the mycological Manuals.

LYCOPERDON *Tourn.*

"Peridium membranaceous, vanishing above or becoming flaccid; bark adnate, subpersistent, breaking up into scales or warts; capillitium soft, dense, adnate to the peridium and sterile base."

The species of Lycoperdon are commonly known as "*puff-balls.*" They belong to a group of fungi scientifically termed Gasteromycetes because of their habit of producing vast numbers of spores in the *gaster* or inner cavity of the plant. The particular order to which they belong is called Trichogasters, a name having reference to the hair-like filaments which are intermingled with the spores and which with them fill the interior of the mature plant. These filaments form a somewhat elastic mass and, being interspersed with vast numbers of minute dust-like spores, if the mature plant is suddenly compressed, they cause it to emit a little cloud of spores which bears some resemblance to a puff of smoke. This probably is the origin of the common name "puff-balls." There are two other closely related genera in this order whose species emit the characteristic puff of spores. One is called Bovista, the other Scleroderma. In the former the outer rind or epidermis disappears as the plant matures and there is no distinct spongy or cellular mass of sterile tissue at the base of the plant. In the latter the walls of the plant are thick and firm when young and they remain in nearly the same condition when mature. In these respects both genera differ from the genus Lycoperdon. In it the fertile part of the plant is more or less globose in shape, but there is always a mass of coarse empty cells at the base which constitute a sterile part of the plant, that is, it produces no spores. In those species which have this part highly developed it constitutes a sort of stem to the fertile part and raises it above the earth or other substance on which the plant grows. When the sterile base is but slightly developed the plant appears to sit directly on the ground or matrix and is then said to be *sessile.*

The exterior coat or rind of the plant consists of two parts. The outer part is sometimes called the *bark*, sometimes the *exterior peridium.* In some species it takes the form of minute flocculent or pulverulent masses or scurf-like scales, in others it consists of weak spines or spine-like bristles, while in others still, the spines are much larger and stouter and are thickened at the base. Such spines are generally more or less angulated and curved. Plants with these coarse long spines are said to be *echinate* because of their stiff bristly aspect. Sometimes several contiguous spines have their tips curved towards each other and united together, thus forming little stellate or star-like clusters. These external processes or adornments are often called *warts* though they may resemble spines rather than warts. In some species they are deciduous at maturity, in others they form a permanent adornment of the inner rind or true *peridium*, but in such cases they usually shrivel with age and become less conspicuous. In a few species the exterior peridium at maturity is separable from the inner and may be peeled off like a thin membrane. The inner or true peridium is at first rather thick and firm, but when fully mature it is generally thin, membranaceous and flaccid. In one section or series of species the upper part when mature breaks up into irregular fragments and soon falls away; in another series it opens by a small apical aperture and then remains in this condition a long time This difference in the mode of rupture in the various species affords a character by which the genus is divided into two sections. The first section answers nearly to the section Bovistoides of Fries; the other nearly to his Proteoides. The former was raised by Rostkovius to the rank of a genus with the name Langermannia, but modern mycologists have generally followed Fries in regarding these species as constituting the single genus Lycoperdon.

The peridium incloses at first a soft fleshy mass of white cellular matter. If a minute portion of this be examined microscopically a great number of jointed filaments and enlarged cells or *basidia* are seen, the latter of which bear slender spicules, usually four each, on the tips of which the spores are borne. When the plant is fully developed this central fleshy substance becomes filled with moisture and quickly changes its color. So abundant is the moistnre that it may be pressed out like water from a wet cloth or sponge. The inexperienced collector is sometimes surprised at finding the moisture in the specimens which he has laid up to dry increasing instead of diminishing, and his surprise is soon changed to disappointment and perhaps annoyance when he sees his beautiful specimens water-soaked and discolored by this superabundance of moisture. In most species the white color of the flesh at first changes to yellowish or greenish-yellow, but this hue soon becomes darker until at last it is generally either a purple-brown or a dingy-olive; that is, brown more or less tinged with dark red, or brown tinged with yellow or greenish yellow. In a few species the final color is less decided, approaching a dark umber or snuff-brown. Sometimes the outer stratum, lying next to and in contact with the inner surface of the peridium, is paler than the rest of the mass. With this change in the color of the interior mass there is also a change no less wonderful in its character. It is now no longer moist and fleshy but dry and dusty. The whole interior is filled with a soft but elastic mass of intricate slender cottony filaments interspersed with countless multitudes of minute dust-like spores. This mass of threads is called the *capillitium*. In some species it is of nearly uniform density throughout, but in others those filaments that spring from the base do not so freely unite and intermingle with those that spring from the walls of the peridium. They therefore form a central mass more or less distinct from the rest and are then called the *columella.*

The columella is usually of a somewhat conical shape, but sometimes it is nearly globose. It may be detected in the mature plant by carefully making two opposite slits in the peridium, extending them from the apex nearly or quite to the base, and then opening the two hemispheres thus formed, the uncut base acting as a hinge on which the halves may turn. The columella if present will be seen projecting from the base in the centre of the cleft. The slits are best made with a pair of small sharp scissors as care should be taken not to disturb the natural position of the filaments more than is necessary.

In the mass the capillitium and spores appear to be uniformly and similarly colored, but often if the filaments are cleared of the spores they are seen to be paler in color. Rarely they are darker. The color of the capillitium and spores might be used as a character for grouping our species in subsections.

The spores in all our species are nearly or quite globose. They vary in size in the different species from .00016 to .00025 of an inch in diameter. The olive tinted spores in nearly all the species are smooth and about .00016 of an inch in diameter, but the purple tinted ones are always rough or echinulate and generally larger, varying from .0002 to .00025 of an inch broad. It is perhaps needless to say that the size of the spores does not at all depend on the size of the plant that produces them. The spores of the Giant puff-ball, the largest one of the genus, are but .00016 of an inch in diameter, while those of the Smooth puff-ball, which is scarcely more than an inch in diameter, are about .00025 of an inch broad. The color of the spores may be ascertained by ejecting a small quantity of them on white paper or by opening the peridium and exposing them to view.

Puff-balls rarely make their appearance in the early part of the season. Old effete specimens of the preceding autumn may be found in early spring flattened and closely pressed to the ground by the snows of winter. Fresh specimens rarely appear before the middle of June. Their greatest abundance is in late summer and early autumn. During the months of August, September and October, most of our species occur. One species I have found in July and August only, another in July only. Some species are invariably found in cleared lands, others in woods or bushy places, while a few are denizens of both field and forest. Some grow on the ground only, others on old logs and decaying wood and a few on both the ground and decaying wood. One southern species is said to inhabit the bark of living oak trees. Some species have distinct whitish root-like fibres at the base. These penetrate the earth and sometimes creep through it for a considerable distance. In the Pear-shaped puff-ball they are generally well developed, and sometimes several individuals are found to be attached together by these creeping subterranean fibres.

In the determination of the species it is desirable to have specimens in both the mature and the immature condition. The former will afford the means of ascertaining the color and character of the capillitium and spores, the latter will exhibit the color of the immature plant and the character of its warts or adornments. The character of these and the characters of the capillitium and spores are of the first importance, but the color of the immature plant and its size and shape are less constant and reliable, and are therefore generally considered of secondary importance. Specimens preserved entire, and in their natural shape are much more satisfactory for study than those that are sliced in sections or pressed flat and mounted on herbarium paper. Such entire specimens can easily be kept in trays or small paper boxes. The immature ones should be gathered just before maturity. If taken too early they shrivel too much and do not keep their shape as well as older ones.

Puff balls are useful because they are edible. None of the species are considered dangerous or even hurtful, yet some are so small and so scarce that they are not of much value for food. The larger ones are generally better flavored than the smaller and more common ones. They should be used as food in the immature condition only, while the flesh is yet of a pure white color. When it begins to discolor its goodness is gone. The method of preparing them for the table is as follows. Take off the rind and cut the fleshy part into thin slices. Beat up two or three or more, eggs according to the quantity to be prepared, and dip the slices in it. Then fry in butter, seasoning with salt, pepper and savory herbs if desired. Another method is to put the slices in water and heat to the boiling point, then take them out and fry in butter as before. Puff-balls as an article of food have this advantage over mushrooms. They are not often infested by insects or their larvæ and there is scarcely any possibility of mistaking any deleterious species for them. In the following descriptions those species whose esculent qualities have been tested by the writer are marked edible.

SYNOPTICAL TABLE OF SPECIES.

Section I. Peridium rupturing irregularly.

Spores smooth .... *a.*
Spores rough...................................... *b.*

a. Plant very large, sessile, spores dingy-olive .. **L. giganteum.**
a. Plant large, with a stem-like base, spores brown **L. cælatum.**
b. Plant large, stem-like base short, spores purple-brown.............................. **L. cyathiforme.**
b. Plant medium size, stem elongated, spores brown.................................... **L. saccatum.**

Section II. PERIDIUM OPENING BY A SMALL APICAL APERTURE.

Subsection A. *Spores purple-tinted.*

Peridium with long stout spines.................................. *c.*
Peridium with minute or medium sized spines..................... *d.*
c. Denuded peridium reticulate.................. **L. constellatum.**
c. Denuded peridium smooth.................. **L. Frostii.**
d. Immature peridium whitish, cinereous or brownish................................ **L. atropurpureum.**
d. Immature peridium yellow.................. **L. glabellum.**

Subsection B. *Spores olive-tinted.*

a. Plant shaggy or echinate.

Plant generally sessile, growing in fields and cleared land........................... **L. Wrightii.**
Plant subsessile, growing in woods and bushy places... *e.*
e. Denuded peridium pitted, spores pedicellate **L. pedicellatum.**
e. Denuded peridium smooth, spores not pedicellate................................ **L. echinatum.**

b. Plant not shaggy.

1. Plant with a a stem-like base (rarely sessile).

Mature peridium obscurely reticulate or marked with minute smooth areolæ...... **L. gemmatum.**
Mature peridium neither reticulate nor marked with dot-like areolæ.................................. *f.*
f. Mature peridium subshining, spores minutely rough.................................. **L. molle.**
f. Mature peridium not shining, spores smooth **L. pyriforme.**

2. Plant without a stem-like base.

Immature plant pinkish-brown............ **L. subincarnatum.**
Immature plant yellowish.................. **L. coloratum.**
Immature plant white or whitish.............................. *g.*
g. Subglobose, growing on the ground......... **L. pusillum.**
g. Globose, growing on trunks of living trees.... **L. leprosum.**
g. Ovate, or conical.............................. **L. calyptriforme.**

Section I. Bovistoides. (Emended).

Peridium rupturing irregularly, the upper part falling away in fragments. Columella none.

In the species of this section, the peridium is apt to crack in areas and at maturity either the whole or the upper part of it breaks up in irregular fragments and falls away. The capillitium and spores are also soon dispersed so that there remains only the sterile base which is sometimes margined by the lacerated but more permanent basal part of the peridium. In this case the remains are somewhat cup-shaped. The bark or warts are usually of a soft floccose character, and generally are not conspicuously developed. This section as here modified receives *L. saccatum* and loses *L. pusillum.*

Lycoperdon giganteum *Batsch.*

Giant Puff-ball.

Very large, 10′–20′* in diameter, obconic or depressed-globose, nearly or quite sessile, white or whitish, becoming discolored by age, smooth or slightly roughened by weak spinules or minute floccose warts, sometimes cracking in areas; capillitium and spores yellowish-green to dingy-olive; spores smooth, .00016′ in diameter. Edible.

Ground in fields, pastures and grassy places.

Buffalo, *Clinton.* Oneida, *Warne.* North Galway, *Teft.* Rensselærville, *Doolittle.* Catskill Mountains, *Paine.* Late summer and autumn. It is also said to occur in North Carolina, Pennsylvania and Minnesota.

This is the largest puff-ball known in this country, and is therefore very appropriately named the giant puff-ball. The species, according to Fries, has also received other names such as *L. maximum* Schæff., the largest puff-ball; *L. Bovista* L., the Bovista-like puff-ball; *L. vulgare* Vaill., the common puff-ball; and *L. Proteus* Sow., the Protean puff-ball. Its dimensions are usually within the limits given in

[1] One accent signifies inch or inches, two accents, line or lines.

the description, but sometimes it grows much larger. Its great size frequently brings it into notice and makes it the subject of short newspaper articles. The following have recently fallen under the observation of the writer, and are introduced here because they indicate the size sometimes attained by this puff-ball: "In a low, moist portion of the Gordon park there grew this fall one of the largest puff-balls (*Lycoperdon giganteum*) ever seen. It measured a little over eight feet in circumference and weighed forty-seven pounds. It looked at a distance like some large boulder. * * A specimen of the above dimensions would be a meal for a good large family. In fact I think it sufficient to appease the appetites of some of the largest European fungus clubs." — *Country Gentleman.* "There was an enormous puff-ball in a bank near the house of the writer this summer. It was eighteen and a half inches in its greatest diameter, and four feet four inches in circumference. These puff-balls have come up in the same place for many years past, and always of a large size, but never before so large as the above."— *Grevillea.* "Among noteworthy specimens seen at the recent Edinburgh Fungus Show was a * * puff-ball (*Lycoperdon giganteum*) fifty-four inches in circumference and weighing twenty pounds."— *Botanical Gazette.* Schweinitz affirms that he found in a certain meadow specimens of this puff-ball three feet in diameter. The largest New York specimen that I have seen is the one contributed by Mr. Warne. It measures fifteen inches in diameter in the dried state. It was considerably larger in the fresh state. The specimen from Rensselaerville is fourteen inches in diameter in the dried state. One writer advises that when one of these large puff-balls occurs at a convenient distance from the house it should not be removed from its place of growth, but that a sufficient quantity be cut from it for a meal. The next day it may be visited again and enough more taken for another meal. In this way it may supply a small family for a week, but if all were taken up and carried to the house at once, some of it would spoil before it could be used. It is said when the growing plant is cut or wounded the wounds heal or fill up with new tissue. Cordier states that the old flesh of this puff-ball is sometimes used for amadou and that the spores are mixed with milk by the Finns to make a medicine for calves afflicted with diarrhea. They are also used, he says, in making various shades of brown paint. The capillitium and spores of this and other species are also said to have been used in stanching blood, and their fumes as an anæsthetic. Fries says that there are two forms of the species, one obconic, the other larger and globose. All the specimens that I have seen were depressed-globose, their vertical diameter being less than their horizontal. As one correspondent expresses it, they were very much like a large loaf of bread in shape and in color. In all our specimens the sterile base is very small in proportion to the size of the plant, so that in the growing state the plant must have appeared quite sessile. Probably the smaller obconic form has a more distinct base, but I have seen no such specimens. According to Fries the species is so variable in size, shape, color and the character of the surface that from these alone it is difficult to distinguish it. All the specimens that I have seen, however, are very distinct by their large size, sessile character and smoothish irregularly rupturing mature peridium.

LYCOPERDON CÆLATUM *Bull.*

Engraved Puff-ball.

Large, 4′–8′ broad, narrowed below into a short stout stem-like base, white, covered with a rather thick mealy or floccose coating which usually breaks up into warts scales or areas and which when old either wholly or partly disappears; obtuse, at length flattened or depressed above, the upper part finally rupturing and leaving a brownish cup-shaped base with a lacerated margin; capillitium and spores dingy-yellow, becoming darker or umber colored with age, the former distinct from the sterile base; spores smooth, .00016′ in diameter.

Meadows, pastures and grassy places. Sheboygan, Wis. *Brown.* Minnesota, *Johnson.* Rocky Mountains, *Berkeley* and *Curtis.* Autumn.

The smaller size, rougher surface and distinct stem-like base distinguish this species from the preceding. The basal remains of the exolete plant are cup-shaped as in the next species but from that it is easily separated by the absence of any purplish or lilac tints. The name has reference to the rough or sculptured surface, the floccose coating breaking up into small areas patches or masses in such a way as to suggest the idea of an engraved surface. After the dispersion of the capillitium and spores the inner surface of the cup appears smooth and even owing to the accurate limitation of the sterile base. It is soft and velvety to the touch. The old and denuded peridium is sometimes smooth, sometimes obscurely areolate. Often it is adorned by persistent scales or patches of the shriveled external coating. The inner dusty mass of spores and filaments is at first greenish-yellow but it becomes darker or brown with age. Dr. Brown, who has tried the edible qualities of this species regards it as excellent. *Lycoperdon Bovista* Pers. is deemed a synonym. The specimens referred here in the *Twenty-third New York State Cabinet Report* were immature and doubtful and therefore mention of their locality is omitted.

Lycoperdon cyathiforme *Bosc.*

Cup-shaped Puff-ball.

Large, 3′–10′ in diameter, nearly globose, generally furnished with a short more or less thick stem-like base, whitish cinereous or pinkish-brown, smooth or minutely floccose, sometimes with minute scattered spinules or floccose scales, generally cracking in areas, the upper part at length falling away in fragments and leaving a cup-shaped base with a lacerated margin; capillitium and spores purple-brown; spores rough, .0002′–.00025′ in diameter. Edible.

Fields and pastures. Buffalo, *Clinton.* Utica, *Johnson.* Fort Edward, *Howe.* Oneida, *Warne.* Albany, Sandlake, Maryland and South Corinth. Vermont, *Frost.* Wisconsin, *Brown.* Carolina, *Bosc, Curtis.* August—October.

Bosc's figure and description of this species, for a transcript of which I am indebted to the kindness of Prof. Farlow, are not very satisfactory. They were evidently derived from the basal remains of the effete plant, a mode of describing fungi scarcely to be recommended. But in this case it happens that there is no other known American puff-ball than the one here described to which in the effete condition his description is applicable, so that there is very little doubt as to the species he intended to describe. A translation of his description is here given.

"Sessile, conical, concave at the top, the margins thin and lacerated.

This species, which occurs in very dry and open places in South Carolina, appears to have some resemblance to *L. infundibulum* Willd. Its color is a grayish-violet more distinct in the cavity. I have never seen it open naturally to disseminate its seeds. Insects which perforate it, the feet of quadrupeds which crush it, winds which blow it against trees supply this want."

The use of the word "sessile" in this description is very natural if we suppose, as Bosc evidently did, the sterile base to be the whole plant in its normal condition. The term "conical" would probably have more accurately conveyed his idea if it had been written *obconical* or *inversely conical.*

This species is probably the same as *L. fragile* Vitt., as suggested by Dr. Berkeley in his *Notices of North American Fungi.* It is also the *L. albopurpureum* Frost in the list of Fungi given in the *Catalogue of Plants growing near Amherst College.* It is the *Bovista cyathiformis* of the *Twenty-second State Cabinet Report* and an immature condition of it was reported and figured in the *Twenty-third State Cabinet Report* under the name *L. giganteum.*

As an edible species it is not inferior to the Giant puff-ball. It is equal to it in flavor and occurs more frequently and in greater numbers. The smaller plants are about the size of a man's fist, the larger ones are as big as a man's head. The short thick stem often penetrates the earth so that the plant appears to be truly sessile. The color is generally brown, more or less tinged with pink or lilac, but sometimes it is nearly white. Usually the upper part cracks into rather large, distinct areas. Just at maturity there is a thin membrane or epidermis which may be separated from the peridium, which is then seen to have a beautiful but minutely velvety surface. It is at this time quite thick but very fragile. The cup-like base which remains after the dispersion of the capillitium and spores is suggestive of the specific name. It is more or less tinged with the purplish-brown hue of the capillitium and frequently persists till the following spring. Sometimes the persistent basal part of the peridium is expanded so that the cup is lost in a nearly plane surface. The color of the capillitium and spores readily separate it from the other species of this section.

LYCOPERDON SACCATUM *Fr.*

Long-stemmed Puff-ball.

Medium size, 2′–4′ high, 1′–2′ broad; peridium depressed-globose or somewhat lentiform, supported by a long stem-like base, furfuraceous with minute persistent mealy or granular warts or spinules, often plicate beneath, white or creamy-white, at maturity becoming brown or olive-brown, subshining and very thin or membranous, breaking up into irregular fragments which sometimes adhere to the capillitium for a considerable time, the stem-like base cylindrical or narrowed downwards, sometimes thick; capillitium rather dense, subpersistent and with the spores dingy-olive or dingy-brown, sometimes verging towards purplish-brown; spores rough, .00016′–.0002′ in diameter. Edible.

Low mossy grounds and bushy swamps, especially under alders. Sandlake, Center and Adirondack Mountains. August — October. It is also said to occur in New England, *Berkeley* and *Curtis*, and in Minnesota, *Johnson.*

The Long-stemmed puff-ball is one of our finest species. Its symmetrical shape, pure color, soft and delicate appearance all conspire to render it attractive. The peridium is sometimes nearly globose, but usually it is more or less depressed and hemispherical or lens-shaped. Its warts are soft and delicate and so minute that to the naked eye the plant appears to be mealy or almost pruinose. They are persistent, but in the mature plant they shrivel or dry up so that they are scarcely noticeable. In the mature plant the peridium shrinks to a thin delicate membrane in which respect it differs from the peridium in the preceding species. The under surface is sometimes marked by radiating folds, and in some instances the stem is also rendered uneven by shallow depressions which give it an undulate appearance. The stem sometimes persists long after the disappearance of the peridium and its contents. Before maturity this species bears some resemblance to *L. molle*, the Soft puff-ball, but when mature the two are easily separated by the different manner in which the peridium ruptures. The American specimens, so far as I have seen them, are smaller and more delicate in appearance than the European specimens that I have, and the mature spores are less strongly warted, but the plants agree fully with the description of the species as given by Fries.

Section II. PROTEOIDES. (Emended.)

Peridium opening by a small apical aperture, persistent. Columella generally present.

In this section the species are more numerous than in the preceding, and the plants are generally more abundant but of smaller dimensions. The peridium persists for a long time and, as its aperture is very small, its capillitium and spores are not so soon dispersed. In some species larger deciduous warts or spines are interspersed among smaller and more persistent ones, in others all the spines are nearly equal and persistent, in a few all are deciduous.

Subsection A. *Spores purple-tinted, intermingled with short fragmentary slender filaments.*

LYCOPERDON CONSTELLATUM *Fr.*

Reticulate Puff-ball.

Peridium subglobose or obovate, sometimes depressed, 10″–18″ broad, echinate with rather long stout crowded brown spines which are either straight curved or stellately united and which at length fall off and leave the surface reticulate with brown lines ; capillitium and spores brown or purplish-brown, columella present; spores rough, .0002′–.00025′ in diameter.

Ground in dense shades and groves. Oneida, *Warne.* Rare. Autumn.

I am not aware that this species has been found in any other locality in this country. I have seen the dried specimens only, but Mr. Warne informs me that the fresh plants do not differ essentially in color from the dried ones. These are of a cervine or dull-brown color closely resembling the hue of the dead and fallen leaves among which they appear to have grown. They are about an inch across and very rough or shaggy with crowded stout spines. When these have fallen the surface is reticulated by a net-work of minutely warted brown lines, a character by which the species is readily distinguished. The species is sometimes represented as having a stem-like base, but our specimens do not show this character nor does Fries mention it in his description. The plant probably varies in this respect.

LYCOPERDON FROSTII *Pk.*

Frost's Puff-ball.

Peridium subglobose, 1′–2′ broad, generally narrowed below into a short stem-like base, echinate or shaggy with long, stout, whitish spines which are generally curved or stellately united and which at length fall off and leave the peridium brown and smooth; capillitium and spores purplish-brown; spores rough, .00016′–.0002′ in diameter.

Ground in meadows. Brattleborough, Vermont. *C. C. Frost.* August and September.

This rare puff-ball differs from *L. constellatum* in its longer paler spines and in having the denuded peridium smooth. I know of no other species which equals it in the length of the spines. After they have fallen, the brown or coppery-brown color of the peridium is visible. The spores are scarcely as large as in the preceeding species nor as closely warted. It is respectfully dedicated to its discoverer.

LYCOPERDON ATROPURPUREUM *Vitt.*

Purple-spored Puff-ball.

Peridium globose depressed-globose or obovate, 6″–30″ broad, generally narrowed below into a short stem-like base, white cinereous or brownish, mealy-spinulose hairy-spinulose echinate or stellately echinate, when denuded smooth and subshining; capillitium and spores finally purplish-brown, columella present; spores rough, .0002′–.00025′ in diameter.

Sandy pastures, woods and bushy places. Common. August — October.

I have observed this species in the following localities;

Albany, Sandlake, Gansevoort, Brewerton, Catskill Mountains and Helderberg Mountains. It appears to be one of our most polymorphous puff-balls. It is so variable that I have been obliged to modify the usual description very much in order to include forms which are quite diverse from each other yet which appear to run together in such a way that I am unable to draw any satisfactory line of distinction between them. The following is the usual description given in the Manuals.

"Peridium flaccid, dingy-rufous, opening by a minute obtuse mouth, bark at first rough with minute spines; sterile base cellular, continuous with the capillitium; spores largish, pedicellate, brown-purple, echinulate."

I do not find the spores in our plant truly pedicellate, but in all the forms which I have referred to this species, and in European specimens of it, as well as in all the species of this subsection, I find them intermingled with short, fragmentary, slender filaments which look very much as if they were pedicels broken from the spores. The spores do not appear to be attached terminally to them but in some instances they appear as if laterally attached. A minute point or apiculus, probably the point of attachment, is visible on the spores, but this is scarcely worthy of being called a pedicel. Neither do the American specimens exhibit a dingy-rufous color, but so variable is the plant that a rigid agreement with the description is scarcely to be expected.

Our specimens group themselves in three principal forms or varieties. The first is usually one or two inches broad, sessile or with a very short stem, nearly smooth, being mealy or pruinose and having a few minute, weak, scattered spinules. Its color is generally whitish or white slightly clouded with brown. It grows in sandy pastures and cleared land and is apparently the nearest of the three in its resemblance to the type.

The second is turbinate or subglobose and narrowed below into a distinct though short stem-like base. It varies in diameter from half an inch to an inch and a half and is thickly beset with slender, bristle-like spinules which are often blackish and give the plant a decidedly hairy aspect. The largest specimens have the spinules a little stouter and sometimes stellately united. Such specimens connect this with the next variety.

The third form varies from one to two and a half inches in diameter, and is generally furnished with a short stem-like base. Its spines are quite coarse and often crowded and stellately united. They give it a decidedly rough or echinate appearance so that at first sight it might be thought a distinct species, but the spines are easily deciduous and individuals occur in which they are more scattered and which have a mealy or pruinose surface, by which characters this variety appears plainly to run into the first. I regard the second and third as worthy of a name and designate and define them as follows.

Var. *hirtellum*. Peridium hairy-spinulose with erect or curved sometimes stellately united spinules, which are often of a blackish color.

Ground and decaying vegetable matter in woods.

Var *stellare*. Peridium echinate or stellately echinate with rather stout easily deciduous spines.

Ground in woods and bushy places.

In this species the capillitium and spores are at first greenish-yellow, olive-tinted or brownish but when fully mature they are purple-tinted. Some care will therefore be necessary lest the last variety be confused with the Echinate puff-ball, *L. echinatum*. This variety was referred in the *Twenty-second N. Y. Cabinet Report* to *L. calvescens* B. & C. on the authority of one of the authors of that species, but when the description of that species was published the reference was found to be erroneous. The larger purple-tinted rough spores forbid such a reference.

Lycoperdon glabellum *Pk.*

Smooth Puff-ball.

Plant subglobose or subturbinate, 8″–18″ broad, sometimes narrowed below into a short stem-like base, yellow or brownish-yellow, furfuraceous with minute nearly uniform persistent warts; capillitium and spores purplish-brown, columella present; spores rough, .0002′–00025′ in diameter.

Ground in pine woods and bushy places. North Greenbush, Albany and Center. Vermont. *Frost.* Autumn.

The Smooth puff-ball is not inferior in beauty to any of our species. Its pretty yellow color and soft smooth appearance readily attract attention. It is generally about one inch in diameter and obovate pyriform or subturbinate in shape. To the naked eye it appears to be smooth or only mealy or minutely papillose, but under a lens it is seen to be covered with minute granular or branny warts. These in all the specimens that I have seen are persistent. The character of the warts and the color of the peridium readily distinguish this species from the preceding one. There is a closely related European species, *L. cupricum* Bon., but that is described as of a cinereous-pink color becoming copper colored when mature and having then a silky or shining surface.

Subsection B. *Spores olive-tinted or brown.*

a. Plant shaggy or echinate.

Lycoperdon Wrightii *B. & C.*

Wright's Puff-ball.

Peridium globose depressed-globose or lentiform, 6″–24″ in diameter, generally sessile, white or whitish, echinate with deciduous sometimes crowded stellate spines or pyramidal warts, when denuded smooth or minutely velvety; capillitium and spores dingy-olive, columella present; spores smooth, .00016′ in diameter. Edible.

Ground in pastures and grassy places. Very common. July—Oct.

This is another very variable species. The typical form was a small one, minutely echinate and having the denuded peridium smooth. The plant often occurs much larger and more coarsely echinate with stout angular spines or pyramidal warts which fall off and generally leave the surface of the peridium velvety. This larger form was published in the *Twenty-sixth Report of the N. Y. State Museum* under the name *Lycoperdon separans*, but the two forms evidently run together. The larger ones sometimes have the denuded peridium smooth and there are other forms intermediate in the size and roughness of the peridium. I have therefore modified the specific description so as to include both so called species. Another puff-ball occurs which is probably a variety of this species but of which I have seen only immature specimens. It is of a purer white color and has the warts or spines tipped with brown or blackish-brown. For the present I have placed it with this species as a variety. It is probable that *L. calvescens* B. & C., is merely another form of the species differing simply in having a stem-like base. The following are the characters of the varieties noticed.

Var. *typicum*. Small, 6″–9″ broad, globose, minutely echinate, the warts quickly falling off and leaving the peridium smooth. (*L. Wrightii* B. & C.)

Var. *separans*. Larger, 10″–24″ broad, subglobose or lentiform, echinate with coarse substellate spines or pyramidal warts which at length fall off and leave the peridium smooth or velvety. (*L. separans* Pk.)

Var. *atropunctum*. Larger, 10″–15″ broad, subglobose, pure white, warts or coarse spines brown or blackish at the tips.

This species is generally gregarious but sometimes it forms tufts of several individuals closely crowded together. It sometimes occurs in cultivated grounds and stubble fields. The under surface is occasionally plicate as in the long-stemmed puff ball. In the variety *separans*, the warts or spines are crowded at their thickened bases and slightly attached to each other so that they come off at maturity in flakes or patches. When the denuded surface of the peridium is velvety it is usually of a darker color than when smooth, being subcinnamon, reddish-brown or dark-brown.

LYCOPERDON PEDICELLATUM *Pk.*

Pedicel-spored Puff-ball.

Peridium 10″–18″ in diameter, globose or depressed-globose, sessile or narrowed below into a stem-like base, whitish or cinereous, becoming dingy or smoky-brown with age, echinate with rather dense spines which are either straight curved or stellately united and which at length fall off and leave impressions or obscure reticulations on the surface; capillitium and spores greenish-yellow, then dingy-olive, columella present; spores smooth, pedicellate, 00016′–00018′ in diameter, the pedicel three to five times as long.

Ground and decaying wood in woods and bushy places. Croghan, Center, Brewerton and Catskill Mountains. Oneida, *Warne.* Autumn.

The pedicellate spores constitute the peculiar feature of this species. It is one which suggests the name and which enables the species to be easily distinguished from all its allies. The spore is terminally and persistently attached to the pedicel as in some species of Bovista. The plant is sometimes sessile, but usually it is narrowed below into a stem-like base. In the immature state it has a rough, shaggy appearance but the spines shrivel with age so that it appears less rough when old. The pitted surface of the denuded peridium affords a mark of distinction from the next species.

L. pulcherrimum B. & C. is evidently the same species. The name here adopted has priority of publication.

LYCOPERDON ECHINATUM *Pers.*

Echinate Puff-ball.

Peridium 10″–18″ broad, subglobose, generally narrowed below into a short stem-like base, whitish brownish or pinkish-brown, echinate above with rather stout spines which at length fall off and leave the surface smooth, towards the base spinulose or furfuraceous; capillitium and spores dingy-olive; spores minutely rough, .00016′ in diameter.

Ground and decaying wood in woods. August—October. Albany, Forestburgh and Adirondack Mountains.

Fries, in his *Systema Mycologicum*, refers this species to *L. gemmatum* as a variety, but it seems to me to be worthy of specific distinction both on account of the different character of its warts, its much more echinate appearance and its smooth denuded peridium. He also gives as synonyoms *L. candidum* Pers., and *L. muricatum* Willd.

The whole plant is generally obovate, pyriform or turbinate, and the spines are larger and more or less curved at and near the apex, but they diminish in size toward the base where they are more persistent. In the immature condition it is difficult to distinguish it from the preceding species, but when mature its smooth peridium and spores destitute of pedicels separate it. It grows chiefly in woods among fallen leaves and on decaying vegetable matter.

b. Plant not shaggy (warts minute except in the first species).

Lycoperdon gemmatum *Batsch.*

Studded Puff-ball.

Peridium 10″–18″ in diameter, globose or depressed-globose, generally narrowed below into a stem-like base, scattered or cæspitose, subumbonate, whitish or cinereous, often tinged with yellow pinkish or brown, warts generally unequal, the larger mostly gemmate or papilla-like, pointed at the apex, scattered among smaller granular and more persistent ones, at length falling off and leaving the surface areolate-dotted or reticulate with a network of fine dotted lines; capillitium and spores greenish-yellow, then dingy-olive or brown, columella present; spores smooth or very minutely rough, .00016′–00018′ in diameter. Edible but not pleasant flavored.

Ground and decaying wood in woods and fields. Very common. July — October.

This is one of the most common and at the same time one of the most variable species. It is therefore more difficult to describe than to recognize after its peculiar appearance is familiar. The most available marks of distinction are the larger erect pointed warts or spinules scattered among the minute ones and giving the surface an appearance somewhat as if studded with gems, and, when these have fallen, the little smooth areolæ or impressions which they leave on the peridium. These are surrounded by the smaller and more persistent warts which usually form fine reticulating dotted lines and render the denuded peridium scabrous. In some instances the warts on the upper part of the peridium are more crowded than usual and nearly uniform in size, but when they fall they leave the usual smooth areolæ where they had stood. The denuded peridium is generally cinereous or grayish and opake. The stem varies very much in thickness and in length. In some instances it is almost entirely wanting, in others it is elongated nearly as much as in the Long-stemmed puff-ball; it may be cylindrical or tapering downwards, nearly equal to the peridium in diameter or very much more narrow. The larger warts, as in the preceding species, generally occur on the upper part of the peridium and near the apex. When these are close together and nearly uniform in size they give the plant a coarsely papillose appearance, and if at the same time the stem is wanting the plant becomes the variety called *papillatum*, or *L. papillatum* Schæff. Such forms occur both with and without the stem-like base, and cannot easily be kept distinct from the ordinary forms of the species. In the variety *hirtum*, or *L. hirtum* Mart., the larger warts are reduced to slender bristle-like spinules, which are often blackish in color, but they have an expanded base, and when they fall off they leave the usual areolæ or impressions and reticulations. Inasmuch, therefore, as the difference in the warts is the only character for distinguishing this plant from the ordinary forms of the species I have followed Fries in regarding it as a mere variety. Dr. Bonorden regards *L. hirtum* as a good species and describes its spines as ventricose and says that they are not surrounded by small warts or papillæ and that they do not fall off and leave areolæ, but dry up and persist, from which it is probable that his plant differs from the one we have in view. Yet our specimens agree so accurately with the characters which Fries assigns to the variety *hirtum*, that we refer them to it with confidence. The following are the characters assigned by him to the two varieties recognized here.

Var. *hirtum.* Turbinate, subsessile, hairy with soft slender warts, which generally became blackish.

Var. *papillatum.* Subrotund, sessile, papillose, furfuraceous-pulverulent.

He also regards *L. excipuliforme* Pers. as a variety of this species, but I have seen no specimens that fully accord with his description, although Schweinitz reports the plant as occurring in North Carolina and Pennsylvania. It is characterized as having a subrotund peridium with scattered subspinulose warts and an elongated stem subplicate at the base.

Typical forms of *L. gemmatum* sometimes have the larger warts blackish or tipped with black and occasionally these warts manifest a tendency to group themselves in a stellate manner. The plant is sometimes cæspitose and forms tufts of considerable extent. Tufts fully two feet in diameter and containing scores of plants crowded together so compactly that their usual rounded form was lost have fallen under my observation.

Lycoperdon molle *Pers.*

Soft Puff-ball.

Peridium 6″ – 16″ broad, globose or depressed-globose, narrowed below into a stem-like base, furfuraceous with nearly uniform persistent minute weak spinules or granular warts, sometimes with a few larger papilliform ones toward the apex, whitish, sometimes tinged with yellow, when mature brownish or olive-brown, nearly smooth, subshining; capillitium and spores dingy-olive, columella present; spores minutely rough; 00016′ – 00018′ in diameter.

Among mosses, especially Polytrichum, in old meadows and pastures. Albany, Summit and South Corinth. Autumn.

This puff-ball closely resembles the ordinary forms of the preceding species in the size, shape and color of the immature plant, and by Fries was referred to it as a variety under the name *furfuraceum.* There may be connecting forms but if so I have not observed them and for the present prefer to keep the two distinct. In this plant the warts or spinules are very small and weak so that it has a smoothish, soft and delicate appearance much like that of *L. saccatum.* They are mostly persistent but they wither or shrivel with age so that the mature peridium appears to the naked eye to be nearly smooth and somewhat glossy or shining. In this respect it differs essentially from the Studded puff-ball. I have never seen it with the pitted, reticulate surface of that species. From the Long-stemmed puff-ball it is with difficulty separated in its immature state, but when mature the different manner in which the peridium in the two species ruptures will at once distinguish them. From its habit of growing among mosses the stem is often elongated and is sometimes very slender in proportion to the size of the peridium. In wet weather the peridium of this and the preceding species manifests a tendency to crack in areas.

LYCOPERDON PYRIFORME *Schæff.*

Pear-shaped Puff-ball.

Plant 6″ – 15″ broad, 10″ – 20″ high, generally cæspitose, obovate pyriform or turbinate, sessile or with a short stem-like base, radicating with white branching and creeping root-like fibres, subumbonate, covered with very minute subpersistent nearly uniform warts or scales, often with a few slender scattered deciduous spinules intermingled, pallid dingy-whitish or brownish; capillitium and spores greenish-yellow, then dingy-olivaceous, columella present; spores smooth, 00016′ in diameter. Edible but not well flavored.

Decaying wood and ground in woods and cleared lands. Very common. July — October.

The Pear-shaped puff-ball sometimes approaches *L. gemmatum* in size and shape, but it is not easily mistaken for that species because of the different character of its warts. They are very numerous, small, nearly uniform in size and appear to the naked eye like branny scales. They are often quite as distinct on the stem as on the peridium. They are rather persistent, but sometimes fall from the upper part of the peridium leaving it smooth and whitish or cinereous. The peridium frequently cracks in areas, especially in wet weather. One form occurs with the peridium abruptly narrowed into a small but distinctly scaly stem, another is of a very pale color and almost smooth, the warts being scarcely visible to the naked eye. In mountainous forests patches of this puff-ball which are several feet in length frequently occur on old prostrate mossy trunks. Whole clusters of young plants may sometimes be obtained attached together by their creeping radicular fibres.

LYCOPERDON SUBINCARNATUM *Pk.*

Pinkish Puff-ball.

Peridium 6″–12″ broad, globose, rarely either depressed or obovate, gregarious or cæspitose, sessile, with but little cellular tissue at the base, covered with minute nearly uniform pyramidal or subspinulose at length deciduous warts, pinkish-brown, the denuded peridium whitish or cinereous, minutely reticulate-pitted; capillitium and spores greenish-yellow, then dingy-olivaceous, columella present; spores minutely rough, .00016′–00018′ in diameter.

Prostrate trunks, old stumps, etc., in woods. Common. August — October.

This is a very distinct species, not likely to be confused with any other. Its peculiar color is quite constant and this, with its minute uniform warts, cæspitose habit, sessile character and pitted denuded peridium, easily distinguish it from all allied species. It rarely exceeds an inch in diameter and I have never found it growing on the ground nor in cleared lands. It often has white creeping radicular fibres similar to those of *L. pyriforme*, and sometimes forms patches equal in extent to those of that species. The little pits or depressions in the denuded peridium are left by the deciduous warts. They are smaller and deeper than the similar impressions of *L. gemmatum* and are not surrounded by dotted lines.

Lycoperdon pusillum *Fr.*

Little Puff-ball.

Peridium 3″–12″ broad, globose, scattered or cæspitose, sessile, radicating, with but little cellular tissue at the base, white or whitish, brownish when old, rimose-squamulose or slightly roughened with minute floccose or furfuraceous persistent warts; capillitium and spores greenish-yellow, then dingy-olivaceous; spores smooth, .00016′ in diameter.

Ground in grassy places and pastures. Common. June — October.

This puff-ball is generally about a half an inch in diameter, but specimens sometimes occur that are scarcely larger than a pea and others that are fully an inch across. It grows in open ground, either on naked soil or among short grass, and is sometimes crowded together in tufts. Its surface is often cracked in areas which are sometimes quite minute, giving the surface a scaly appearance. Rarely the warts are in the form of minute branny spinules or stellate hairs. They are generally persistent but in the mature plant they are so shriveled that they are scarcely noticeable. It occurs throughout the season, sometimes appearing in the month of June. Its smoother surface and different warts will readily distinguish it from small forms of *L. Wrightii* and *L. gemmatum* var. *papillatum.*

Lycoperdon leprosum *B. & R.*

Leprous Puff-ball.

Peridium 3″–5″ broad, globose, sessile, white, with a minutely scaly or leprous coating of floccose filaments; capillitium and spores greenish-yellow; spores smooth, .00016′ in diameter.

Among moss on trunks of living oak trees. Aiken, South Carolina. *Ravenel.*

This is a very small species, being in the dry state scarcely larger than a marrowfat pea. It closely resembles small forms of the preceding species from which it may be separated by its softer and more tomentose coating, its paler capillitium and spores and its peculiar habitat. Indeed I know of no other species that inhabits the trunks of living trees. I have seen no published description of this species and have been obliged to derive the one here given entirely from the dried specimens kindly communicated by Mr. Ravenel.

Lycoperdon coloratum *Pk.*

Colored Puff-ball.

Peridium 5″–10″ broad, globose or obovate, subsessile, radicating, yellow or reddish-yellow, brownish when old, slightly roughened with minute granular or furfuraceous persistent warts; capillitium and spores at first pale, inclining to sulphur color, then dingy-olive; spores subglobose, smooth, about .00016′ in diameter.

Ground in thin woods and bushy places. Sandlake and Catskill Mountains. Rare. July and August.

This delicate little puff-ball is quite rare. It is generally about a half an inch broad and nearly globose, though sometimes it is narrowed towards the base where it is usually furnished with a few delicate white radicular fibres. The color of the immature plant is yellowish and quite conspicuous, but when old it so closely resembles the dead brown color of the fallen leaves among which the plant grows, that it is difficult to detect it. But few individuals are found in one place. The warts are very minute and easily overlooked. They have a granular, or almost mealy appearance and when old they usually become blackish. At first the capillitium and spores appear to have a sulphur-yellow color, but when fully mature, if the capillitium is cleared of the spores it is seen to be much darker. There is a slight depression in one side of the spore so that when viewed in a particular direction it appears flattened or depressed on one side, although if viewed in a different direction it may appear globose.

LYCOPERDON CALYPTRIFORME *Berk.*

Conical Puff-ball.

Peridium about 6″ high, 3″–4″ broad, ovate or subconical, sessile, whitish, furfuraceous with minute warts or spinules; capillitium and spores olivaceous or yellowish-olivaceous; spores smooth, .00016′ in diameter.

Moss covered rocks. Adirondack Mountains. Very rare. August.

I have met with this very small and rare species but once, and then only two specimens were found. In these the apex was compressed or laterally flattened instead of being papilliform as required by the original description of the species, but in all other respects the specimens exhibit the specific characters. This puff-ball is very distinct from all our other species by its ovate or conical shape. Probably *L. acuminatum*, B. & C. of the Catalogue of North Carolina Plants is another name for this species.

Of the nineteen species already described I have seen specimens. All except three are known to occur in the State of New York. Of the more common ones the localities are not given. They probably occur in nearly all the states of the Union. A few yet remain of which I have seen no specimens or only imperfect ones. Of these I quote the descriptions as I find them, merely adding a few comments.

LYCOPERDON CURTISII *Berk.*

Curtis's Puff-ball.

"About one-third of an inch across, springing from a short rooting base; globose, rough with echiniform warts, pallid; flocci, and the smooth, globose spores, .0001′ in diameter, clay colored. North Carolina, *Curtis*, Connecticut, *Wright.*" *Grevillea*, vol. 2, p. 50.

The small size of the spores, if the diameter is correctly given, will distinguish this species from all our other puff-balls. I have seen no specimens.

LYCOPERDON CALVESCENS *B. & C.*

"About one inch and one-fourth across, springing from a short rooting base, at first clothed with minute echinate warts, which soon drop off, and leave the peridium minutely velvety. Capillitium and even globose spores, .00016′ in diameter; clay-colored. The spores appear at first to be pedicellate, but if so the pedicels soon drop off. Connecticut, *Wright.*" L. c. pp. 50 and 51.

I have seen only a single authenticated but dried and pressed specimen of this and I can not consider it specifically distinct from *L. Wrightii.* As already shown, the velvety surface of the denuded peridium is not a good specific character. There remains then only the short stem-like base to separate *L. calvescens* from *L. Wrightii*, and this is scarcely of specific value. Indeed in my copy of Ravenel's Fungi Car. Exsic., of the specimens labelled "Lycoperdon gemmatum Fr.," Fasc IV, number 73, two individuals have the stem-like base, while the third is without it. The two answer exactly to the description of

L. calvescens, the third is *L. Wrightii* var. *separans*. All should in my opinion be referred specifically to *L. Wrightii*. Those with a stem might be distinguished as *L. Wrightii* var. *calvescens*.

LYCOPERDON CRUCIATUM *Rostk.*

"Cruciate, peridium membranaceous, persistent, spines arranged in a cross-like manner, falling off in fragments, spores yellowish-brown.' Sturm's Deutschlands Flora, Heft XVIII, p. 19. "Rhode Island, *Olney*." *Grevillea* vol. 2, p. 51.

Of the Rhode Island specimens referred to this species I have seen but a single immature one. This did not show the cruciate character of the spines from which the species takes its name, nor could I find in it any mark by which to separate it from *L. Wrightii*.

Prof. Farlow, to whom I am indebted for favors in this connection, informs me that the spores in his specimens are smooth, a fact which strengthens my opinion that the Rhode Island specimens should not be separated from *L. Wrightii*. Some forms of Wright's puff-ball exhibit the same characters that are ascribed to the spines of *L. cruciatum*, but others do not. Rostkovius, neither in his figure nor in his description, gives any of the characters of the spores of his species except the color, and that is by no means an uncommon or peculiar one, so that although there are indications that *L. cruciatum* and *L. Wrightii* may be the same species, Rostkovius's description is too imperfect to enable us to reach any definite conclusion in this respect.

LYCOPERDON DELICATUM *B. & C.*

"About two and a half inches across, base more or less stem shaped, one and a half to two and a half across, spongy, accurately separated as in *L. cœlatum* from the capillitium; peridium pruinose-furfuraceous, very delicate, capillitium with the globose even spores, .00016′ in diameter, yellowish here and there, inclining to pinkish. A very delicate looking species, with a stout base. Pennsylvania, *Michener*. No. 3621, 3622." *Grevillea*, vol. 2, p. 51.

The description of this species leaves us in the dark concerning the manner in which the peridium ruptures, nor does the single imperfect specimen which I have seen throw any light on this point. If the peridium opens by a small apical aperture the species seems too near *L. molle.* If it ruptures irregularly it will be separable from *L. saccatum*, so far as the description goes, only by the smooth spores and the accurately limited capillitium. From *L. cœlatum* its smaller size and smoother peridium would apparently be its distinguishing features.

Schweinitz in his *Synopsis of the Fungi of Carolina* and *Synopsis of North American Fungi* reports some species not yet mentioned but as I have had no opportunity of consulting his specimens nothing positive can be affirmed con cerning them.

L. Bovista in *Syn. Car. Fung.* he says varies with a purplish colored dust, from which it is probable that he includes under this name both *L. cyathiforme* and *L. cœlatum*. *L. umbrinum* I suspect may be equal to *L. gemmatum* var. *hirtum* as a synonym of which it is given in Smith's *English Flora* *L. perlatum* he refers in his *Syn. N. A. Fung.* to *L. maximum*, which in turn is given by Fries as a synonym of *L. giganteum.* His *L. candidum* he afterwards referred to *L. areolatum*, another probable synonym of *L. cœlatum.* *L. pratense*, according to Fries, is synonymous with *L. pusillum*, and *L. excipuliforme*, as already stated, is regarded as a variety of *L. gemmatum.* There then remains only *L. quercinum* and *L. utriforme* of his lists which may possibly be unlike anything already noticed but about which there is so much uncertainty that not even a conjectural reference would be of any value.

Lycoperdon heterogeneum Bosc, according to Schweinitz, is his *Mitremyces lutescens.*

Lycoperdon Warnei Pk. is shown by specimens recently collected in Wisconsin by Mr. Bundy to be a Podaxon and should be referred to that genus as *Podaxon Warnei* Pk.

LIST OF PUBLICATIONS CONSULTED.

Fries' Systema Mycologicum.
Berkeley's Outlines of British Fungology.
Smith's English Flora.
Cooke's Handbook of British Fungi.
Schweinitz's Synopsis of the Fungi of Carolina.
Schweinitz's Synopsis of North American Fungi.
Sturm's Deutschlands Flora.
Botanische Zeitung.
Journal of the Linnean Society.
Grevillea.
Bulletin of the Buffalo Society of Natural Science.
Bulletin of the Torrey Botanical Club.
Reports on the N. Y. State Cabinet of Natural History.
Reports on the N. Y. State Museum of Natural History.
Bulletin of the Minnesota Academy of Natural Science.
Ravenel's Fungi Caroliniani Exsiccati.
Curtis's Catalogue of North Carolina Plants.
Lea's Catalogue of Plants of Cincinnati.
Tuckerman and Frost's Catalogue of Plants near Amherst College.

NOTE.— Since this paper went to press I have seen a part of one of the type specimens of *L. delicatum* from the Herbarium of Dr. Michener. This indicates that the species is a good one but closely allied to *L. cœlatum,* from which it differs in its smaller size smoother surface and, when mature, in the peculiar dingy-pinkish hue of the capillitium and spores. The peridium in this example manifests a tendency to crack in areas as in *L. cœlatum* and it is thicker and firmer than the peridium of *L. saccatum.*

Dr. Michener also finds *L. Frostii* in Pennsylvania.

MANUAL OF THE ALBANY INSTITUTE.

The origin of the Albany Institute dates back, through other organizations of which it is the legitimate successor, to the year 1791.

"The Society, instituted in the State of New York. for the Promotion of Agriculture, Arts and Manufactures" was formed in February, 1791, at the city of New York, then the seat of government of this state, and was incorporated by the Legislature, March 12th, 1793. Of this body, Robert Robert Livingston (well known as one of the committee appointed to draft the Declaration of Independence, first Chancellor of the Court of Chancery of the State of New York, Minister Plenipotentiary to France, etc.), was designated in the act of incorporation as the first president, and so remained until the year 1804, when the act expired by its own limitation. In eight years, this Society published a quarto volume of Transactions, in four successive parts, and also an octavo edition of same.[1] The society was then reincorporated under the title of "The Society for the Promotion of Useful Arts," by an act of the Legislature, passed April 2, 1804, which also constituted Mr. Livingston its first president. Of the labors of this Society, it is enough to say that three octavo

[1] Society, instituted in the state of New York, for the promotion of agriculture, arts and manufactures. Transactions of the: part I, II, III, IV. Published by order of the society.

New York, 1792, 1794; Albany, 1798, 1799, pp. xv, 122, xlv, 230, xli, 129, vi, 178. In 1 vol. 4to.

—— The same. The second edition revised. Albany, 1801, pp. 418, 8vo.

—— Some articles found in the first edition are omitted in the second.

volumes, mainly composed of communications read at its sessions, were published;[1] that it exerted a most favorable influence upon agriculture; and that it was for five years the organ of the state in distributing premiums for improvements in domestic manufactures.

The premium specimens of domestic woolens, mounted in five folio scrap books, are still preserved in the Institute library.

"The Albany Lyceum of Natural History" was organized early in 1823, under the presidency of Stephen Van Rensselaer, and was incorporated by the Legislature on the 23d day of April in that year. Directing its labors to the advancement of a knowledge of the natural sciences, it succeeded in forming a museum embracing collections in the various branches, especially geology, mineralogy and palæontology, which were for a time regarded as the most extensive and valuable in the country.

Circumstances induced a majority of the members of the two latter societies to believe that the objects for which they had been incorporated would be promoted by mutual coöperation; and accordingly, in May, 1824, articles of association were agreed to, providing for the organization of "The Albany Institute." The substance of these articles is embodied in the charter granted by the Legislature, February 27th, 1829. It appears from the above that the Albany Institute is the legitimate successor of the pioneer series of associations formed and incorporated within this state for the promotion of science. Its membership has in-

[1] Society for the promotion of useful arts in the state of New York: Transactions, vol. 2, 3, 4: parts 1, 2. Albany 1807, 1814, 1816, 1819. 3 vols., 8vo. Volume 1 is under the first title of the society above.

cluded many persons of distinction as scholars, and also in professional and civil life. Its standard publications are eight volumes of *Transactions*, two volumes of *Proceedings*, and a volume entitled *Field Meetings of the Albany Institute.*[1]

The charters of the first three of these societies are printed in vol. VI of the Institute *Transactions*, which also contains the first edition of the *Manual* of the Institute, prepared in 1870.[2] A new edition of the *Manual* is furnished in the present publication.

A printed copy of the "First Annual Report of the Albany Institute, presented July 1, 1825," eight pages octavo, is preserved in Pamphlet volume No. 210, of the Institute Library.

For a number of years subsequent to the organization of the Institute, the several departments were accustomed to hold regular meetings for the transaction of their appropriate business, during which period new

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[1] Transactions of the Albany Institute. Albany, 1830. Part I, pp. vii, 250; Part II, appendix pp. 74, 6 plates. Vol. II, 1833–52, pp. viii, 354. 8 plates. Vol. III, Catalogue of the Library. 1855, pp. vii, 454. Vol. IV, 1858–64, pp. viii, 323. Vol. V, 1867, pp. v, 327, 6 plates. Vol. VI, 1870, pp. iv, 382. Vol. VII, pp. iv, 351, 3 plates. Vol. VIII, 1876, pp. v, 307. 8 vols., 8vo.

Proceedings of the Albany Institute, from March, 1865 to Sept., 1872. Vol. I, pp. 400. Vol. II, Oct., 1872 to Dec., 1877. Albany, 1873, 1878, 2 vols., 8vo.

Field Meetings of the Albany Institute, 1870–75. Albany, 1876, pp. 150, 8vo.

This record of the field meetings is also included in the volumes of *Proceedings*, in continuous paging.

[2] Manual of the Albany Institute: Prepared under the order of the Institute, March, 1870, by Daniel J. Pratt, Recording Secretary, Albany 1870, pp. 48, 8vo.

Manual of the Albany Institute. New Edition, 1878, pp. 29, 8vo.

corresponding and resident members were added to the Institute only by virtue of election to some one of these departments. More recently, while the organization of the departments has been preserved in accordance with the provisions of the charter, the proceedings have been almost wholly conducted by the Institute at large, and new members have not generally been elected to, or classified among the various departments. "Classes in the Several Departments" have been constituted as provided by the 21st by-law, and several reports have from time to time been made by some of these classes.

CHARTER OF THE ALBANY INSTITUTE.

AN ACT *to incorporate the Albany Institute.* Passed February 27, 1829. Chap. 43.

WHEREAS the Society for the Promotion of Useful Arts, and the Albany Lyceum of Natural History, have agreed to articles of association, for the purpose of forming an Institution for the promotion of Science and Literature, to be called "The Albany Institute." Therefore,

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

§ 1. All such persons as shall at the time of the passage of this act, be members of the said "Society for the Promotion of Useful Arts," or of the "Albany Lyceum of Natural History," and such other persons as shall from time to time become members of the same, or of the third department herein after mentioned, shall be and are hereby constituted a body corporate and politic, by the name of "The Albany Institute;" and the annual income of the real and personal estate which the said corporation is authorized to hold, shall not exceed ten thousand dollars.

§ 2. The said corporation shall consist of three departments, viz: First, the department of Physical Sciences and the Arts: Second, the department of Natural History, and, Third, the department of History and General Literature. "The Society for the Promotion of Useful Arts," as at present constituted, shall be the First Department — "The Albany Lyceum of Natural History," as at present constituted, the Second Department; and a Society for the promotion of History and General Literature shall be formed as soon as may be, which shall be the Third Department: but until such society shall be formed and duly organized, the said corporation shall consist and be formed of the aforesaid First and Second Departments.

§ 3. The officers of the said corporation shall be a president, three vice-presidents, three corresponding and three recording secretaries; a treasurer, a librarian, and as many curators as the Second Department may direct. The president and treasurer shall be annually elected; and the presidents of the departments shall be the vice-presidents; and the corresponding and recording secretaries of the departments shall be the corresponding and recording secretaries of the Institute; the librarian of the First Department shall be the librarian, and the curators of the Second Department shall be the curators of the Institute: Stephen Van Rensselaer shall be the first president, and Simeon De Witt, at present president of the Society for the promotion of Useful Arts, and Theodoric Romeyn Beck, at present president of the Albany Lyceum of Natural History, shall be the vice-presidents, and William Mayell the treasurer of the Institute; who shall severally hold their respective offices until others shall be chosen in their places.

§ 4. The elective officers shall be chosen by a plurality of the votes of the members of the Institute present, at a regular meeting for that purpose convened, according to the by-laws of the Institute, of which previous notice shall be given in at least one of the newspapers published in the city of Albany.

§ 5. If at any regular meeting of the Institute for the election of officers, any or either of the Departments constituting the Institute shall not continue organized or be in any way dissolved, such officers of the Institute as are hereby declared to be *ex officiis* from the said Departments, may be elected by the Institute in the same manner as the other elective officers are directed to be chosen.

§ 6. Nine members of the Institute, regularly convened, shall constitute a quorum for the transaction of business, and five members of either of the Departments regularly convened, shall constitute a quorum for the transaction of business in such department.

§ 7. The books now belonging to or hereafter coming into the possession of the aforesaid Departments, shall be deposited in the library of the said corporation, and all specimens of natural history or the arts, now or hereafter belonging to or coming into the possession of either of the said departments, shall be deposited in the museum of the said corporation.

§ 8. The corporation shall have power to make, constitute, ordain and establish such by-laws and regulations as they shall judge proper for the election of their officers, for prescribing their respective functions and the mode of discharging the same, for the admission of new members, for the government of the officers and members thereof, for collecting the fines, impositions and annual contributions from the members, for regulating the times and places of meeting, and for managing and directing the affairs and concerns of the said corporation.

§ 9. The legislature may at any time hereafter amend, modify or repeal this act.

BY-LAWS OF THE ALBANY INSTITUTE.

[Adopted May 5th, 1824; amended April 1st, 1829; Jan. 4th and 18th, Feb. 1st, March 15th, and Dec. 20th, 1870; March 21st, Nov. 7th, 1871; Jan. 6, 1874, and Oct. 29, 1878: the amendments being incorporated in the text.]

I. Meetings.

1. The regular meetings of the Institute shall be held once a fortnight during the first six and the last three months of the year.

2. The first meeting in each year shall be held on the first Tuesday succeeding the first day of January, at which time the annual election for officers shall be held; the Recording Secretary to give general notice of the same.

3. At the anniversary meeting, the order of business shall be as follows:

(1.) Call to order by the presiding officer.

(2.) Reading of the minutes of the last meeting.

(3.) Election of officers.

(4.) Report from the Recording Secretary of the number of members admitted during the preceding year.

(5.) Report from the Treasurer of the moneys received and expended during the year.

(6.) Report from the Librarian of the number of books received during the year, the number issued to members during the year, and the number not returned according to regulations.

(7.) Report from the Curators of the number of specimens, natural and artificial, added to the collections.

(8.) Appointment of committees to examine the above reports.

(9.) Amendments to the by-laws duly proposed at a previous meeting.

4. At the other regular meetings, business shall be transacted in the following order:

(1.) Call to order by the presiding officer.

(2.) Reading of the minutes of the last meeting.

(3.) Communications, papers, lectures, etc.

(4.) Reports of committees.

(5.) Miscellaneous business.

5. Special meetings may at any time be called by the presiding officer, upon giving notice in one of the daily city newspapers, or by messenger.

II. Duties of Officers.

6. The President shall preside at all the meetings, nominate and appoint all committees, have a casting vote in case of a tie, declare the decisions of the Institute, and call extraordinary meetings when he shall consider them necessary.

7. In the absence of the President, one of the Vice Presidents shall preside, who shall have all the powers granted to the President.

8. In addition to the Recording Secretaries of the several departments, there shall be chosen annually a Recording Secretary for the Institute at large, who shall keep the minutes of the Institute, give notice of the anniversary and other meetings, notify new members of their election, and transact such other business as may be directed by the by-laws, or by a vote of the

Institute. In the absence of the Recording Secretary, one of the Recording Secretaries of the Departments shall perform the duties of his office, on the request of the President.

9. A Corresponding Secretary of the Institute at large shall also be elected annually. He shall conduct the correspondence of the Institute, and shall from time to time communicate such information as he may have received relative to its objects. In his absence, one of the Corresponding Secretaries of the departments shall perform his duties, on the request of the President.

10. The Treasurer shall receive the moneys belonging to the Institute, keep an account of all receipts and expenditures, and pay accounts as follows:

For periodicals directed to be taken, to be audited by the Librarian, who shall certify that he has received the same.

For contingent expenses, to be certified by the President or either of the Vice Presidents.

For other purchases or expenditures directed by a vote of the Institute, to be certified by the Recording Secretary with a copy of the minutes relative thereto.

11. The Curators shall take charge of such specimens in Natural History and the Arts as may from time to time be received by the Institute, either on loan or by donation; in the former case, they may give receipts for specimens subject to the direction of the person who may deposit the same, and they shall keep the collections under such regulations as may be prescribed.

12. The Librarian shall take charge of all the books and manuscripts belonging to the Institute or on de-

posit. He shall loan no books except to members, and in such cases only in conformity with such regulations as may be prescribed. He shall keep a record, in a book kept for that purpose, of all books loaned to the members, and when returned, and shall at each annual meeting report in writing the condition of the Library, the number of volumes received during the year, the number issued to members during the year, and the number not returned according to regulations.

13. The same person may, if the Institute so elect, hold at the same time the offices of Recording Secretary, and Librarian; and the Institute shall pay to such person, holding either or both of these offices, such an annual salary as shall from time to time be decided upon at an annual meeting.

III. Members.

14. There are three classes of members, to wit: Resident, Corresponding and Honorary. Resident members only shall be entitled to vote and to hold office.

15. Candidates for membership shall be nominated at a regular meeting, and their names, together with the names of members proposing them, shall be entered on the minutes. The vote on such nominations shall be taken at the next or some subsequent regular meeting, by ballot. An affirmative vote of eight-ninths of the members voting, and at least nine affirmative votes, shall be necessary to an election, and at least two negative votes shall be required to exclude a candidate; but membership shall not be complete until the annual fee for the year shall be paid. Persons who have been unsuccessful candidates for admission shall

not be again proposed as members for at least three months.

16. The annual fee of each resident member shall be five dollars, payable on the first of January, in advance; but the payment of twenty-five dollars by or for any clergyman of the city of Albany, duly elected a resident member, shall exempt him from any further payment.

17. The Honorary Members heretofore elected by the several departments are hereby recognized as Honorary Members of the Institute; but no additional Honorary Members shall be recognized, unless elected by the Institute at large.

18. The Governor of the state and the Mayor of the city of Albany shall be *ex officio* Honorary Members; and shall be entitled to all the privileges of resident members, except the right of voting.

19. A member of any of the departments may become a member of either of the others, on being duly elected and paying the initiation fees and annual contributions required by the by-laws of such department.

20. No member of one department shall be transferred to another, without the consent of the department which he leaves, and that of the Institute.

IV. Classes in the Several Departments.

21. The President of each of the Departments shall, at the annual meeting or the first meeting thereafter, announce the names of at least three classes within his department, of one of which he shall be chairman; each class to consist of three or more members. The duty of these classes or committees shall be, to report annually to the Institute such notes or selected items

as may present a brief record of matters of interest in science and literature. They shall report in such order as the Recording Secretary shall arrange at the commencement of the year.

These classes shall be:

In the First Department (*Physical Science and the Arts*):

1. On Physics and Astronomy.
2. On Physiology and Chemistry.
3. On Arts.

In the Second Department (*Natural History*):

1. On Geology.
2. On Botany.
3. On Zoology.

In the Third Department (*History and General Literature*):

1. On Modern History, especially historical records possessing local interest.
2. On Ancient History and Archæology.
3. On General Literature.
4. On Political and Social Science.
5. On Philology, Ethnology and Anthropology.

Other classes may be formed whenever it is desirable.

The reports of these classes are not to take the place of the usual original communications and papers.

V. Miscellaneous.

22. A by-law of any of the departments which may conflict with any of the by-laws of the Institute, shall be deemed void and of no effect.

23. No exchange or sale of any property of either of the departments shall be valid, unless approved by the Institute.

24. An address shall be delivered before the Institute during the month of May in each year. The election of the person to deliver the annual address shall be held at least a year previous; and on at least a fortnight's previous notice.

25. The Rules of Order for the Institute shall be those of the Assembly of this State.

26. No alteration shall be made in the by-laws, unless proposed at a regular meeting, at least four weeks previous to being acted on, nor without the concurrence of two-thirds of the members present.

CATALOGUE OF THE MEMBERS OF THE ALBANY INSTITUTE.

HONORARY MEMBERS.

Additional to those elected prior to March, 1870, as shown by Catalogue of that date. (*Transactions*, VI, 332 — 339.)

1873	Thomas Davidson,	Brighton, Eng.
1872	Paul B. Du Chaillu,	New York.
1873	Alexander S. Johnson, LL.D.,*	Utica.
1872	John Tyndall,	England.

CORRESPONDING MEMBERS.

Elected since March, 1870.

1873	Charles T. Andrews,	Watkins.
1874	Dr. F. T. Berg,	Stockholm, Sweden.
1873	Samuel Brown,	London, Eng.
1873	Paul F. Chadbourne, LL.D.,	Williamstown, Mass
1872	Rev. Lewis P. Clover, D.D.,	Greenbush.
1876	Le Roy C. Cooley, Ph. D ,	Poughkeepsie.
1875	James Cruikshank, LL.D.,	Brooklyn.
1875	Willard Fiske,	Ithaca.
1875	John Foster, LL.D.,	Schenectady.
1873	Levi M. Gano,	Watkins.
1874	Theodore Gill,	Washington, D. C.
1876	Robert S. Hale, LL.D.,	Elizabethtown.
1872	Morven M. Jones,	Utica.
1873	Andrew McMillan,	Utica.
1871	George W. Mowbray,	North Adams, Mass.
1870	Asher P. Nichols,	Buffalo.
1872	John A. Paine, Ph D.,	Albany.
1875	Maurice Perkins, M.D.,	Schenectady.
1875	Eliphalet N. Potter, D.D.,	Schenectady.
1874	Count Leon Pulslovski,	Warsaw, Russia.
1872	James W. Reilly, U. S. A.,	West Point.
1876	Carl Schurz,	St. Louis, Mo.
1876	Norman Seymour,	Mt. Morris.
1873	Thomas Bond Sprague,	Edinburgh, Scotland
1873	Wm. Thomas Thomson,	Edinburgh, Scotland.
1873	Cornelius Walford,	London, Eng.
1874	Harrison E. Webster,	Schenectady.
1876	Samuel R. Welles, M.D.,	Waterloo.
1874	Alexander Winchell, LL.D.,	Syracuse.

*Deceased.

RESIDENT MEMBERS.

1867 Rev. Reinhold Adelberg.
1867 Joseph Alden, D.D., LL.D.
1823 Joseph Alexander.*
1870 Chauncey W. Allen.
1864 Leicester Allen.
1869 Rev. John M. Allis.
1830 William Alvord.*
1823 Julius R. Ames.*
1878 Richard L. Annesley.
1836 William Annesley.*
1841 Charles H. Anthony.*
1865 Oliver Arey.
1840 James H. Armsby, M.D.*
1841 Charles L. Austin.*
1875 John C. Austin, D.S.
1859 Horace Averill.
1866 Daniel L. Babcock.
1864 James L. Babcock, M.D.
1831 Marshall J. Bacon.
1870 James S. Bailey, M.D.
1867 John M. Bailey.
1870 William H. Bailey, M.D.
1830 Henry W. Bamman.*
1865 Robert L. Banks.
1833 Daniel D Barnard.*
1852 Frederick J. Barnard.*
1851 Samuel W. Barnard.
1876 Thurlow Weed Barnes.
1852 William Barnes.
1875 Walton W. Battershall, D.D.
1871 Isaac Battin.
1852 Rufus G. Beardslee.
1830 Lewis C. Beck, M.D.*
1829 Nicholas F. Beck, LL.D.*
1812 T. Romeyn Beck, M.D., LL.D.*
1869 Thomas Beckett, M.D.
1852 Luther F. Beecher, D.D.
1876 Willard Bellows.
1852 Ephraim H. Bender.
1870 Henry M. Benedict.*
1841 Lewis Benedict, Jr.*
1866 George H. Benjamin.
1876 Daniel C. Bennett.
1871 Ebenezer J. Bennett.
1872 James P. Bennett.
1870 John M. Bigelow, M.D.
1871 Anson Bingham.
1859 Reuben H. Bingham.
1874 Joseph H. Blatner, M.D.
1874 James H. Blessing.
1829 S. De Witt Bloodgood.*
1869 Rev. William S. Boardman.
1830 William H. Bogart.
1877 Lewis Boss.
1870 James L. Bothwell.
1866 Arthur Bott.
1872 Loren R. Boyce, M.D.
1851 David I. Boyd.
1833 William S. Boyd.
1810 John M. Bradford, D.D.*
1869 John E. Bradley.
1870 Chas. De W. Bridgman, D.D.
1871 Gilman P. Briggs.*
1859 Marshall K. H. Bright.
1840 Edward Brinckerhoff.*
1832 Henry Bronson, M.D.
1877 Jonas H. Brooks.
1852 A. Hyer Brown.*
1860 Andrew E. Brown.*
1829 Rev. David Brown.
1873 Hamilton B. Brown.
1870 James C. Brown.
1823 Jesse Buel.*
1864 Henry T. Buell.
1829 Peter Bullions, D.D.*
1825 Asa Burbank, M.D.
1832 Henry Burden (Troy).
1863 Edward E. Burnet.
1874 Charles H. Burton.
1852 Walter R. Bush.
1830 Benjamin F. Butler, LL.D.*
1830 William Caldwell.*
1873 Charles Callaway.
1813 Archibald Campbell.*
1858 Duncan Campbell.
1839 John N. Campbell, D.D.*
1851 William H. Campbell, D.D.
1869 Edward A. Carpenter, M.D.
1875 Edward M. Carpenter.
1829 George W. Carpenter.
1841 Ezra R. Carr.
1858 Howard Carroll.*
1876 Russell C. Case.
1831 John P. Cassidy.*
1857 William Cassidy.*
1865 Michael P. Cavert.
1878 Eugene T. Chamberlain.
1870 Frank Chamberlain.
1866 Alfred F. Chatfield.
1830 Asa Chester, M.D.
1815 John Chester, D.D.*
1836 Charles Clapp.
1824 Walter Clark.*
1851 William W. Clark.

*Deceased.

1827 Aaron Clarke.*
1831 George Clarke.
1826 George W. Clinton, LL.D.
1831 William D. Cochran.
1836 Mason F. Cogswell, M.D.*
1874 Lewis Collins.
1835 Andrew J. Colvin.
1868 Verplanck Colvin.
1823 Alfred Conkling.*
1833 Lawrence Connor.
1851 George H. Cook, LL.D.
1867 Leroy C. Cooley.
1865 John A. Cooper.
1857 John Tayler Cooper.*
1858 Paul F. Cooper.
1876 Thomas C. Cooper.
1830 William Cooper.*
1870 Clarence H. Corning.
1828 Erastus Corning.*
1873 Erastus Corning.
1878 Erastus Corning, Jr.
1873 Edgar Cotrell.
1872 Henry Crandell.*
1876 Monroe Crannell.
1874 William W. Crannell.
1826 Alonzo Crittenden, Ph.D.
1823 Edwin Croswell.*
1857 James Cruikshank, LL.D.
1840 Thomas H. Cushman.*
1831 William M. Cushman.
1873 E. Pemberton Cutler.
1869 Edward Danforth.
1867 Henry Darling, D.D.
1857 Gilbert C. Davidson.*
1873 Estes H. Davis, M.D.
1867 James Davis.
1832 John Davis.*
1832 Amos Dean, LL.D.*
1829 Jesse De Graff.
1874 Baron De La Rochette.
1828 Edward C. Delavan.*
1869 Philander Deming.
1835 Hugh Denniston.*
1876 Charles Devol, M.D.
1870 Abraham V. DeWitt.
1831 Lewis De Witt.*
1827 Richard Varick De Witt.*
1857 Richard Varick De Witt.
1806 Simeon De Witt.*
1827 George Dexter.
1834 James Dexter.*
1830 John Ogden Dey.*
1871 William Dey Ermand.
1871 William G. Dey Ermand.
1874 Martin L. Deyo.
1872 Isaac De Zouche, M.D.
1870 Andrew Dickey.

*Deceased.

1871 Walter Dickson.
1867 George L. Ditson, M.D.
1833 John A. Dix, LL.D.
1869 Rt. Rev. Wm. C. Doane, D.D.
1842 Edwin A. Doolittle.
1833 O——— M. Dorman.
1863 Lockwood L. Doty.*
1877 Eugene Douglass.
1870 Volckert P. Douw.*
1832 Volkert P. Douw.*
1828 Charles E. Dudley.*
1823 Edward Dunn.*
1876 Allen B. Durant.
1870 Edward P. Durant.
1870 Clarence E. Dutton, U. S. A.
1866 Alfred Edwards.*
1866 Isaac Edwards.
1823 James Edwards.*
1823 James Eights, M.D.*
1812 Jonathan Eights, M.D.*
1866 Joachim Elmendorf, D.D.
1865 George V. Emerson.*
1869 James H. Emerton.
1872 Charles F. Emery.
1873 Horace H. Emery.
1842 Ebenezer Emmons, M.D.*
1874 James O. Fanning.
1872 Hiram Ferguson.
1835 James Ferguson.*
1830 Isaac Ferris, D.D., LL.D.*
1830 Lancelot Fidler.*
1871 Charles H. Fisher.
1829 Peter Fleming.
1868 Townsend Fondey.
1832 William H. Fondey.*
1833 Edward W. Ford.*
1833 John M. Ford.
1871 Henry L. Foreman.
1834 William W. Forsyth.*
1851 Samuel H. Freeman, M.D.
1851 Abel French.
1833 James M. French.*
1832 William W. Frothingham.*
1866 Robert M. Fuller.
1806 Peter Gansevoort.*
1815 Peter Gansevoort.*
1877 James T. Gardner.
1872 Henry W. Garfield.
1834 Rev. John M. Garfield.
1871 Merrill E. Gates.
1869 Charles H. Gaus.
1841 John E. Gavit.*
1857 Joseph Gavit.
1857 John P. S. Gifford.
1825 James S. Goold.*
1852 John Gott.
1858 Benjamin A. Gould, Jr., M.D.

1836 Charles D. Gould.*
1868 William J. Graff.
1878 Rev. Frederick O. Grannis.
1875 Stephen R. Gray.
1815 Matthew Gregory.
1828 Henry Greene, M.D.*
1874 Thomas L. Greene.
1870 Stephen B. Griswold.
1878 Edward A. Groesbeck.
1852 Stephen Groesbeeck.*
1809 Henry Guest.*
1857 William Hagen, M.D.
1872 William Hailes, Jr., M.D.
1871 Matthew Hale.
1871 Silvester Hale.
1871 William H. Hale, Ph.D.
1851 James Hall, LL.D.
1841 John H. Hall.*
1867 John Tayler Hall.*
1870 Lewis Benedict Hall.
1867 Samuel Hand.
1870 Thomas L. Harison.
1833 Thomas W. Harman.*
1851 Ira Harris, LL.D.*
1833 Henry Hart.*
1833 Seth Hastings.*
1851 Henry B. Haswell.*
1878 Rev. James Haughton.
1823 Gideon Hawley, LL.D.*
1851 Henry Q. Hawley.
1868 Adelbert D. Head, M.D. (Troy).
1858 James Hendrick.
1823 Joseph Henry, LL.D.*
1871 D. Cady Herrick.
1872 Isban Hess.
1871 George W. Heywood.
1857 John H. Hickcox.
1871 Aaron Hill.
1874 William W. Hill.
1871 Charles Hilton.
1833 Robert J. Hilton.*
1868 John V. R. Hoff.
1865 Peter Hogan.
1876 Thomas W. J. Holbrook.
1868 Almon Holland.
1869 Alexander L. Holley (Troy).
1877 John McC. Holmes, D.D.
1857 Henry A. Homes, LL.D.
1814 Philip Hooker.*
1869 Charles E. Horne.
1841 Eben N. Horsford.
1855 Franklin B. Hough, M.D.
1860 George W. Hough.
1866 John C. House (Waterford).
1819 Estes Howe.*
1872 George R. Howell.
1870 Charles S. Hoyt, M.D.
1833 Lorenzo Hoyt.*
1835 Levi Hubbell.
1832 Correll Humphrey, M.D.*
1867 Edward R. Hun, M.D.
1828 Thomas Hun, M.D.
1871 Dexter Hunter.
1871 Albert N. Husted.
1878 Albert N. Husted.
1873 Stephen C. Hutchins.
1872 Stephen A. Ingham, M.D.
1859 George P. Jackson.
1832 William Jackson.
1858 William A. Jackson.*
1842 Edward James.*
1831 Henry James.
1831 John James, M.D.*
1875 William G. Janes.
1831 John B. Jarvis.
1867 Charles M. Jenkins.
1808 Elisha Jenkins.*
1857 Ezekiel Jewett.*
1857 Alexander S. Johnson, LL.D.*
1857 Benjamin P. Johnson.*
1851 James I. Johnson, LL.D.*
1877 Robert L. Johnson.
1838 Hugh B. Jolly.
1877 Charles E. Jones, M.D.
1869 Morven M. Jones.
1870 William V. Jones.
1828 Oliver Kane.*
1833 Robert L. Kearney.*
1875 David H. Keefer.
1831 Rev. William L. Keese.*
1870 James B. Kelley.
1858 Edward E. Kendrick.*
1870 Addison A. Keyes.
1869 Emerson W. Keyes.
1866 James Kidd.
1866 Rodney G. Kimball
1866 Dwight King.
1831 Joshua I. King.
1872 Peter Kinnear.
1865 Leonard Kip.
1852 Rt. Rev. William I. Kip, D.D.
1871 Charles R. Knowles.
1878 Senzaburo Kodzu.
1866 William Lacy.
1833 John B. La Forge.*
1866 Abraham Lansing.
1842 Charles B. Lansing.
1864 John V. Lansing, M.D.
1874 Joseph A. Lansing.
1876 Ralph P. Lathrop.
1829 Augustus F. Lawyer, M.D.
1866 William L. Learned, LL.D.
1878 Maurice J. Lewi, M.D.
1866 George W. Lewis.

*Deceased.

1815 Stewart Lewis.*
1869 Joseph A. Lintner.
1851 Edwin C. Little.
1828 Weare C. Little.
1833 Cicero Loveridge.*
1808 James Low, M.D.*
1858 David B. Luther.*
1851 William J. McAlpine.
1876 Alexander McBride.
1857 Henry S. McCall.
1852 William McCammon.
1808 William McClelland, M.D.*
1841 Archibald McClure.*
1877 James H. McClure.
1872 Thomas E. McClure.
1857 Amasa McCoy.
1829 William A. McCulloch.
1836 Alexander B. McDoual.*
1852 William McElroy.
1866 Robert Macfarlane.
1867 William C. McHarg.
1836 Archibald McIntyre.*
1851 John McD. McIntyre.
1855 Rev. Robert McKee.*
1878 St. Clair McKelway.
1823 Duncan McKercher.*
1833 David McLaughlan, M.D.
1823 James McNaughton, M.D.*
1869 James McNaughton, C.E.
1878 John W. McNamara.
1875 Irving Magee, D.D.
1852 Henry Mandeville, D.D.*
1851 Henry March, M.D.*
1828 William L. Marcy, LL.D.*
1852 Benj. N. Martin, D.D., L.H.D.
1835 Henry H. Martin.
1867 Henry T. Martin.
1826 William Martin.
1869 Selden E. Marvin.
1863 James Weir Mason.
1877 Andrew E. Mather.
1830 Frederick Matthews.*
1815 William Mayell.*
1870 George W. Maynard.
1860 Melvin N. Mead, M.D.
1823 Orlando Meads.
1828 Henry D. Meech.
1830 Richard M. Meigs.
1875 Rev. Wm. R. G. Mellen.
1876 George R. Meneely.
1871 Lansing Merchant.
1870 Otto Meske.
1874 Frederick Meyer.
1873 Gustav Michaelis.
1806 Rev. Alexander Miller.
1876 Ernest J. Miller.
1873 Peyton F. Miller.

*Deceased.

1852 Rev. William A. Miller.*
1823 William C. Miller.*
1870 Theodore F. Miner.
1859 W——— C. Minor.
1876 Nathaniel C. Moak.
1840 Julien Molinard.*
1865 Levi Moore, M.D.
1866 William D. Morange.
1872 Wm. Morgan, M.D.
1869 Cornelius D. Mosher, M.D.
1863 Jacob S. Mosher, M.D.
1827 Isaac Mott.*
1824 Joseph P. Mott.*
1841 Joel Munsell.
1871 Frank A. Munson, M.D.
1867 Frederick W. Munson.*
1873 Samuel L. Munson.
1857 David Murray, Ph. D.
1842 David Newcomb, M.D.
1830 George Newell.
1835 George W. Newell.*
1852 John Newland.
1833 Luke F. Newland.*
1876 Rev. Frederick M. Newman.
1876 De Azro A. Nichols.
1852 Richard H. Northrop.*.
1830 John T. Norton.*
1870 John T. Norton.
1834 Howard Nott.*
1852 Edward B. O'Callaghan, M.D., [LL.D.
1830 William O'Donnell, M.D.*
1852 Thomas W. Olcott.
1874 George D. Olds.
1870 Abraham F. Onderdonk.
1859 Lysander A. Orcutt.
1851 Abijah Osborn.
1830 John K. Paige.*
1863 Henry D. Paine, M.D.
1869 Horace M. Paine, M.D.
1873 Edward D. L. Palmer.
1857 Erastus D. Palmer.
1875 Erastus D. Palmer.†
1851 Amasa J. Parker, LL.D.
1866 Amasa J. Parker, Jr.
1829 Philip S. Parker.*
1831 William Parmelee.*
1842 L. Sprague Parsons.*
1869 Wesley W. Pasko.
1833 John Paterson.
1814 George Pearson.*
1841 Erastus H. Pease.
1841 Frederick S. Pease.*
1869 Charles H. Peck.
1851 George R. Perkins, LL.D.*
1842 John S. Perry.
1875 Nathan B. Perry.
1851 William F. Phelps.

†Re-elected.

1877 William L. M. Phelps.
1834 Henri Picard.*
1872 Henry R. Pierson.
1816 Charles Z. Platt.*
1852 Josiah B. Plumb.
1865 James E. Pomfret, M.D.*
1840 Horatio Potter, D.D.
1829 Titus W. Powers, M.D.
1865 Daniel J. Pratt, Ph.D.
1875 Sartell Prentice.
1877 Richard Prescott.
1871 Henry G. Preston, M.D.
1867 Erastus C. Pruyn.
1831 John V. L. Pruyn, LL.D.*
1877 John V. L. Pruyn.
1833 Lansing Pruyn.
1870 Robert C. Pruyn.
1839 Robert H. Pruyn, LL.D.
1842 Samuel Pruyn.*
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1858 Joel Rathbone.*
1851 John F. Rathbone.
1867 John Meredith Read, Jr.
1858 Charles B. Redfield.*
1852 James Redfield.*
1869 J. Livingston Reese, D.D.
1810 John Reid.*
1872 James W. Reilly, U. S. A.
1872 Rev. Charles Reynolds.
1852 Dexter Reynolds.
1841 Marcus T. Reynolds.*
1828 Walter G. Reynolds.
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1816 Hugh Robison.*
1871 Lewis H. Rockwell.
1829 William S. Rockwell.*
1871 Edward D. Ronan.
1834 Arthur H. Root.*
1865 Simon W. Rosendale.
1859 George S. Rugg.
1878 Jacob G. Runkle.
1870 Charles E. Russ.
1871 Rev. Edwin B. Russell.
1878 Henry Russell.
1864 Joseph W. Russell.
1872 Charles E. Sackett.
1877 Joseph S. St. John.
1851 James H. Salisbury, M.D
1878 Ira B. Sampson.
1865 James B. Sanders.*
1859 Joseph P. Sanford.
1878 Grange Sard.
1851 Edward Satterlee.
1871 Eugene H. Satterlee.
1869 Louis M. Sautter.
1837 P——— B. Savery.
1869 John G. Saxe.
1863 William C. Schuyler.
1852 Oliver Scovill.*
1873 G. Hilton Scribner.
1871 Charles Sedam.
1870 George Seeley.
1876 John F. Seman.
1852 Rev. John Sessions.*
1815 Joseph Shaw, LL. D.*
1859 Ashbel K. Shepard.
1835 Watts Sherman.*
1841 Andrew Shiland.
1876 Hiram E. Sickels.
1871 George W. Sill.
1862 Thomas Simonds.
1875 Nathan E. Simons.
1870 Theron Skeel.*
1869 George S. Skilton.
1830 Elisha W. Skinner.*
1869 William S. Smart, D.D.
1851 Adam R. Smith.
1870 Charles E. Smith.
1878 Erastus C. Smith.
1869 James H. Smith.
1868 J. Moreau Smith.
1830 John S. Smith.
1870 J. Wesley Smith.
1868 Louis B. Smith.*
1876 Norman L. Snow, M.D.
1815 Henry W. Snyder.*
1830 William Souls.*
1842 Arthur C. Southwick.*
1871 Benjamin R. Spelman.
1833 William Spencer.*
1872 Charles T. F. Spoor.
1830 William B. Sprague, D.D.*
1869 Samuel T. Sprecher, D.D.
1858 Eben S. Stearns.
1868 Rev. Florida Steele.
1823 Oliver Steele.*
1835 Samuel Steele.
1873 Clarence Sterling.
1867 George T. Stevens, M.D.
1841 Samuel Stevens.*
1812 James Stevenson.*
1869 Daniel M. Stimson, M.D.
1871 John B. Stonehouse, Jr., M.D.
1851 Alfred B Street.
1873 Alfred W. Street.

*Deceased.

1841 Anthony M. Strong.
1859 Richard M. Strong.*
1872 James H. Sutherland.
1858 Richard W. Swan.
1851 Azor Taber.*
1841 S. Visscher Talcott.
1834 William H. Talcott.
1806 John Tayler.*
1870 Alfred H. Taylor.
1857 George W. Taylor.
1818 John Taylor, Jr.*
1871 William H. Taylor.
1841 Robert E. Temple.*
1874 John Templeton.
1861 Elisha Y. Ten Eyck.
1870 James Ten Eyck.
1823 Philip Ten Eyck, M.D.
1875 Jonathan Tenney.
1873 David A. Thompson.
1869 Lemon Thomson.
1876 Charles Tillinghast.
1832 Ambrose S. Townsend.
1851 Franklin Townsend.
1851 Frederick Townsend.
1851 Howard Townsend.*
1875 Howard Townsend.
1835 Isaiah Townsend.*
1830 John Townsend.*
1830 John F. Townsend, M.D.*
1852 Robert Townsend.*
1851 Theodore Townsend.
1830 James G. Tracy.*
1867 John G. Treadwell.
1878 Grenville Tremain.*
1871 Gilbert M. Tucker.
1867 Luther H. Tucker.
1873 Willis G. Tucker, M.D.
1828 William Tully.*
1851 William A. Tweed Dale.*
1865 Rev. Alexander S. Twombly.
1870 Anson J. Upson, D.D.
1875 William T. Valentine.
1871 Adam Van Allen.
1870 Garrett A. Van Allen.
1871 Thomas J. Van Alstyne.
1871 William C. Van Alstyne.
1868 John H. Van Antwerp.
1875 William M. Van Antwerp.
1866 Arthur L. Van Benthuysen.
1874 Clarence Van Benthuysen.
1872 Frank Van Benthuysen.
1841 Isaac Vanderpoel.*
1833 James Vanderpoel.* [LL.D.
1851 S. Oakley Vanderpoel, M.D.,
1870 Albert Van Derveer, M.D.
1875 Andrew Vanderzee.
1852 Henry H. Van Dyck.

1835 Harmanus S. Van Ingen.*
1828 Cortlandt Van Rensselaer.*
1863 Eugene Van Rensselaer.
1829 John S. Van Rensselaer.*
1827 Philip S. Van Rensselaer.*
1806 Stephen V Rensselaer, LL.D.*
1823 Stephen Van Rensselaer, Jr.*
1832 William P. Van Rensselaer.*
1851 Alfred Van Santvoord.
1809 Anthony Van Schaick.*
1806 Gerrit Van Schaick.*
1830 John B. Van Schaick.*
1872 Eugene Van Slyke, M.D.
1842 Abraham Van Vechten.*
1823 Jacob T. B. Van Vechten.*
1820 Teunis Van Vechten.*
1852 Hooper C. Van Voorst.
1851 Maurice E. Viele.
1858 Adolph Von Steinwehr.*
1870 Edward Wade.
1877 Charles D. Walcott.
1872 Frederick E. Wadhams.
1877 James E. Walker.
1832 Henry A. Walker.
1823 John S. Walsh.*
1831 William Walsh.*
1870 Charles W. Ward.
1832 Robert E. Ward.
1876 Samuel B. Ward, M.D.
1877 James M. Warner.
1874 John DeWitt Warner.
1867 James D. Wasson.*
1868 Daniel Waterbury.
1878 Edward P. Waterbury.
1857 Robert H. Waterman.
1815 Charles R. Webster.*
1810 George Webster.*
1831 Horace B. Webster.*
1827 Matthew Henry Webster.*
1830 Rev. Henry R. Weed.*
1857 Harvey Wendell.
1832 Herman Wendell, M.D.*
1851 John J. Wendell.*
1812 Peter Wendell, M.D.*
1832 Philip Wendell.*
1870 William Wendell.
1841 Jacob I. Werner.
1830 Rensselaer Westerlo.*
1842 Henry G. Wheaton.*
1871 Charles F. Wheeler.
1870 Jesse M. White.*
1864 William J. White.*
1870 Robert P. Whitfield.
1811 Elias Willard, M.D.*
1857 Sylvester D. Willard, M.D.*
1870 Diedrich Willers, Jr.
1852 Chauncey P. Williams.

*Deceased.

1871 Robert D. Williams.
1871 William H. Williams.
1871 James C. Wilsdon.
1858 Gilbert L. Wilson.*
1859 Jacob Wilson.
1832 James M. Wilson.
1837 John Wilson.*
1870 John M. Wilson (Col.), U. S. A.
1815 Joel A. Wing, M.D.*
1841 John Winne.
1869 George Wolford.
1869 Rev. Abel Wood.
1831 Bradford R. Wood.
1876 J. Hampden Wood.
1830 Samuel M. Woodruff.*
1857 William L. Woollett.*
1857 Samuel B. Woolworth, LL.D.
1877 Frank P. Wright.
1852 William Wrightson.*
1830 John W. Yates.*
1828 Richard Yates.*
1851 William A. Young.

Whole number of Resident Members, from the organization of the Institute to January, 1, 1879, ... 694

*Deceased.

ACTING RESIDENT MEMBERS.

DECEMBER 31, 1878.

Richard L. Annesley,
57 North Pearl.

John C. Austin, D.S.,
14 North Pearl.

Daniel L. Babcock,
Bassett, corner Franklin.

John M. Bailey,
120 Lancaster.

Thurlow Weed Barnes,
61 State.

William Barnes,
Western avenue, near Robin.

Walton W. Battershall, D.D.
31 Lodge street.

Isaac Battin,
128 Grand.

Thomas Beckett, M.D.,
276 Washington avenue.

Willard Bellows,
80 Grand.

Daniel C. Bennett,
108 Jay.

Reuben H. Bingham,
Surveyor's Office, City Hall.

Joseph H. Blatner, M.D.,
71 Hudson avenue.

James H. Blessing,
Townsend's Furnace, cor. B'dway and Rensselaer.

Lewis Boss,
Dudley Observatory.

Arthur Bott,
294 State.

Jonas H. Brooks,
Exchange Bank,
450 Broadway.

Hamilton B. Brown,
2 Clinton Square.

Charles H. Burton,
183 Hamilton.

Duncan Campbell,
62 Chapel.

Edward M. Carpenter,
188 Washington avenue.

Russell C. Case,
Albany City Nat. Bank.
47 State.

Eugene T. Chamberlain,
270 Hamilton.

Frank Chamberlain,
270 Hamilton.

Alfred F. Chatfield,
66 Chestnut.

Andrew J. Colvin,
77 State.

Verplanck Colvin,
77 State.

Paul F. Cooper,
10 Elk.

Thomas C. Cooper,
81 Lancaster.

Erastus Corning,
87 State.

Erastus Corning, Jr.,
22 Elk.

Monroe Crannell,
69 State.

Wm. W. Crannell,
59 State.

Edward Danforth,
462 Broadway.

Philander Deming,
City Hall.

Charles Devol, M.D.,
48 Franklin.

William Dey Ermand,
276 Hamilton.

William G. Dey Ermand,
15 Ten Broeck.

Martin L. Deyo,
178 State.

Andrew Dickey,
115 Hudson avenue.

Walter Dickson,
186 Elm.

Rt. Rev. Wm. C. Doane, D.D.,
29 Elk.

George Doelker,
Beaver Block, South Pearl.

Eugene Douglass,
756 Broadway.

Allen B. Durant,
177 Swan.

Edward P. Durant,
455 Broadway.

Isaac Edwards, LL.D.,
74 State.

James O. Fanning,
11 High.

Thomas H. Fearey,
287 State.

Hiram Ferguson,
94 Jay.

Townsend Fondey,
451 Broadway.

James T. Gardner,
84 Lancaster.

Henry W. Garfield,
Albany City Nat. B'k, 47 State.

Merrill E. Gates,
229 Madison avenue.

Joseph Gavit,
52 North Pearl.

Rev. Frederick O. Grannis,
71 Lancaster.

Edward A. Groesbeck,
Commercial Bank, 38 State.

William Hailes, Jr., M.D.,
197 Hamilton.

Matthew Hale,
25 North Pearl.

William H. Hale, Ph.D.
50 Clinton avenue.

James Hall, LL.D.,
State Museum of Natural History, corner of State and Lodge.

Samuel Hand,
220 State.

Rev. James Haughton,
3 Columbia Place.

James Hendrick,
Hope Bank, 65 State.

William W. Hill,
112 Eagle.

Charles Hilton, C.E.,
105 Lancaster.

Peter Hogan,
270 Madison avenue.

Thomas W. J. Holbrook,
32 Maiden Lane.

John McC. Holmes, D.D.,
91 Lancaster.

Henry A. Homes, LL.D.,
State Library.

George R. Howell,
State Library.

Charles S. Hoyt, M.D.,
11 High.

Edward R. Hun, M.D.,
31 Elk.

Thomas Hun, M.D.,
31 Elk.

Dexter Hunter,
cor. Lumber and Ten Broeck.

Albert N. Husted,
29 Jay.

George P. Jackson,
Townsend's Furnace, cor. Broadway and Rensselaer.

William G. Janes,
Amer. Express Co.'s Office.

Charles M. Jenkins,
60 North Pearl.

Robert L. Johnson,
221 State.

Charles E. Jones, M.D.,
140 State.

James Kidd,
7 Elk.

Peter Kinnear,
64 Beaver.

Leonard Kip,
6 Tweddle Hall.

Charles R. Knowles,
148 Lancaster.

Abraham Lansing,
55 State.

John V. Lansing, M.D.,
83 Hawk.

William L. Learned,
298 State.

Maurice J. Lewi, M.D.,
cor. Westerlo and Trinity Place.

Joseph A. Lintner,
State Mus'm of Nat. History, corner State and Lodge.

Weare C. Little,
525 Broadway.

Alexander McBride,
61 State.

Henry S. McCall,
5 Douw's Building, cor. State and Broadway.

James H. McClure,
196 State.

St. Clair McKelway,
Argus Office.

John W. McNamara,
82 State.

James McNaughton, C.E.,
244 State.

Irving Magee, D.D.,
9 Lodge.

Henry H. Martin,
152 State.

Henry T. Martin,
152 State.

Andrew E. Mather,
447 & 449 Broadway.

Orlando Meads,
4 Pine.

George R. Meneely,
30 Elk.

Lansing Merchant,
45 Trinity Place.

Otto Meske,
520 Broadway.

Ernest J. Miller,
89 Hawk.

Nathaniel C. Moak,
34 Lancaster.

Levi Moore, M.D.,
59 Congress.

Jacob S. Mosher, M.D.,
3 Lancaster.

Joel Munsell,
82 State.

Samuel L. Munson,
246 Hudson avenue.

Rev. Frederick M. Newman,
679 Broadway.

DeAzro A. Nichols,
395 Broadway.

John T. Norton,
300 State.

George D. Olds,
229 Madison avenue.

Horace M. Paine, M.D.,
105 State.

Erastus D. Palmer,
5 Fayette.

John Paterson,
103 Ten Broeck.

Charles H. Peck,
State Museum of Nat. History, corner State and Lodge.

John S. Perry,
111 Washington avenue.

Nathan B. Perry,
115 Hudson avenue.

Wm. L. M. Phelps,
158 Jay.

Henry R. Pierson, LL.D.,
440 Broadway.

Daniel J. Pratt, Ph.D.,
142 Lancaster.

Sartell Prentice,
283 Broadway.

Richard Prescott,
High School.

John V. L. Pruyn,
19 Elk.

Robert H. Pruyn, LL.D.,
156 State.

Charles H. Ramsey,
133 Eagle.

Joseph H. Ramsey,
133 Eagle.

Edward W. Rankin,
31 North Pearl.

Joel R. Ransom,
6 Elk.

Clarence Rathbone,
5 Elk.

J. Livingston Reese, D.D.,
80 Lancaster.

Edward D. Ronan,
3 Tweddle Hall.

Simon W. Rosendale,
147 Lancaster.

Jacob G. Runkle,
262 Broadway.

Henry Russell,
133 Elm.

Joseph S. St. John,
Normal School.

Ira B. Sampson,
157 Lancaster.

Joseph P. Sanford,
91 Columbia.

Grange Sard,
166 Washington Avenue.

George Seeley,
Compt's office, State Hall.

John F. Seman,
Broadway, cor .Maiden Lane.

Hiram E. Sickels,
25 North Pearl.

Nathan E. Simons,
26 First.

Charles E. Smith,
26 Lancaster.

Erastus C. Smith,
767 Broadway.

Norman L. Snow, M.D.,
70½ Hudson avenue.

Benjamin R. Spelman,
582 Broadway.

Charles T. F. Spoor,
26 North Pearl.

George T. Stevens, M.D.,
47 Eagle.

John B. Stonehouse, Jr., M.D.,
5 High.

Alfred B. Street,
16 Dove.

James H. Sutherland,
61 Green.

Alfred H. Taylor,
Adj. Genl's Office, Capitol.

John Templeton,
Albany County Bank,
cor. State and North Pearl.

James Ten Eyck,
37 Dean.

Philip Ten Eyck, M.D.,
64 Lancaster.

Jonathan Tenney,
474 Madison avenue.

David A. Thompson,
53 Chapel.

Lemon Thomson,
8 Ten Broeck.

Charles Tillinghast,
178 State.

Franklin Townsend,
4 Elk.

Frederick Townsend,
2 Elk.

Howard Townsend,
21 Elk.

Gilbert M. Tucker,
395 Broadway.

Luther H. Tucker,
174 Washington avenue.

Willis G. Tucker, M.D.,
4 Lancaster.

Anson J. Upson, D.D.,
78 Chapel.

William T. Valentine,
143 Lancaster.

Garret A. Van Allen,
24 Lancaster.

Thomas J. Van Alstyne,
9 Douw's Building.

John H. Van Antwerp,
N. Y. State Nat. B'k, 69 State.

Wm. M. Van Antwerp,
162 Washington avenue.

Arthur L. Van Benthuysen,
407 Broadway.

Chas. Van Benthuysen [Hon. Mem.]
407 Broadway.

Clarence Van Benthuysen,
8 Elk.

Frank Van Benthuysen,
407 Broadway.

S. Oakley Vanderpoel, M.D., LL.D.,
144 State.

Albert Van Derveer, M.D.,
28 Eagle.

Andrew Vanderzee,
Beaver Block,
South Pearl.

Theodore V. Van Heusen,
470 Broadway.

Eugene Van Rensselaer,
Manor House, Broadway.

Maurice E. Viele,
41 State.

Edward Wade,
293 Hamilton.

Charles D. Walcott,
State Mus'm of Nat. History,
cor. State and Lodge.

James E. Walker,
453 Broadway.

Samuel B. Ward, M.D.,
135 North Pearl.

James M. Warner,
97 Lancaster.

Edward P. Waterbury,
25 North Pearl.

Charles F. Wheeler, D.S.,
48 North Pearl.

Robert P. Whitfield,
169 Elm.

Chauncey P. Williams,
284 State.

William H. Williams,
488 Broadway.

George Wolford,
302 State.

J. Hampden Wood,
7 Tweddle Hall.

Frank P. Wright,
90 Jay.

William A. Young,
Hope Bank, 65 State.

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INDEX.

ERRATUM.

Page 337. For "1878, John W. McNamara," read 1869, John W. McNamara. This name is also out of its alphabetical order.

EXPLANATION OF PLATE I.

LEPIDONOTUS SQUAMATUS *Kinb.*

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Fig. 1. Head of a small specimen, × 25.
Fig. 2. Foot seen from below, × 25.
Fig. 3. Seta of ventral ramus, × 140.
Fig. 4. Seta of dorsal ramus, × 240.
Fig. 5. Seta of first ventral ramus, × 240.

LEPIDONOTUS VARIABILIS *n. sp.*

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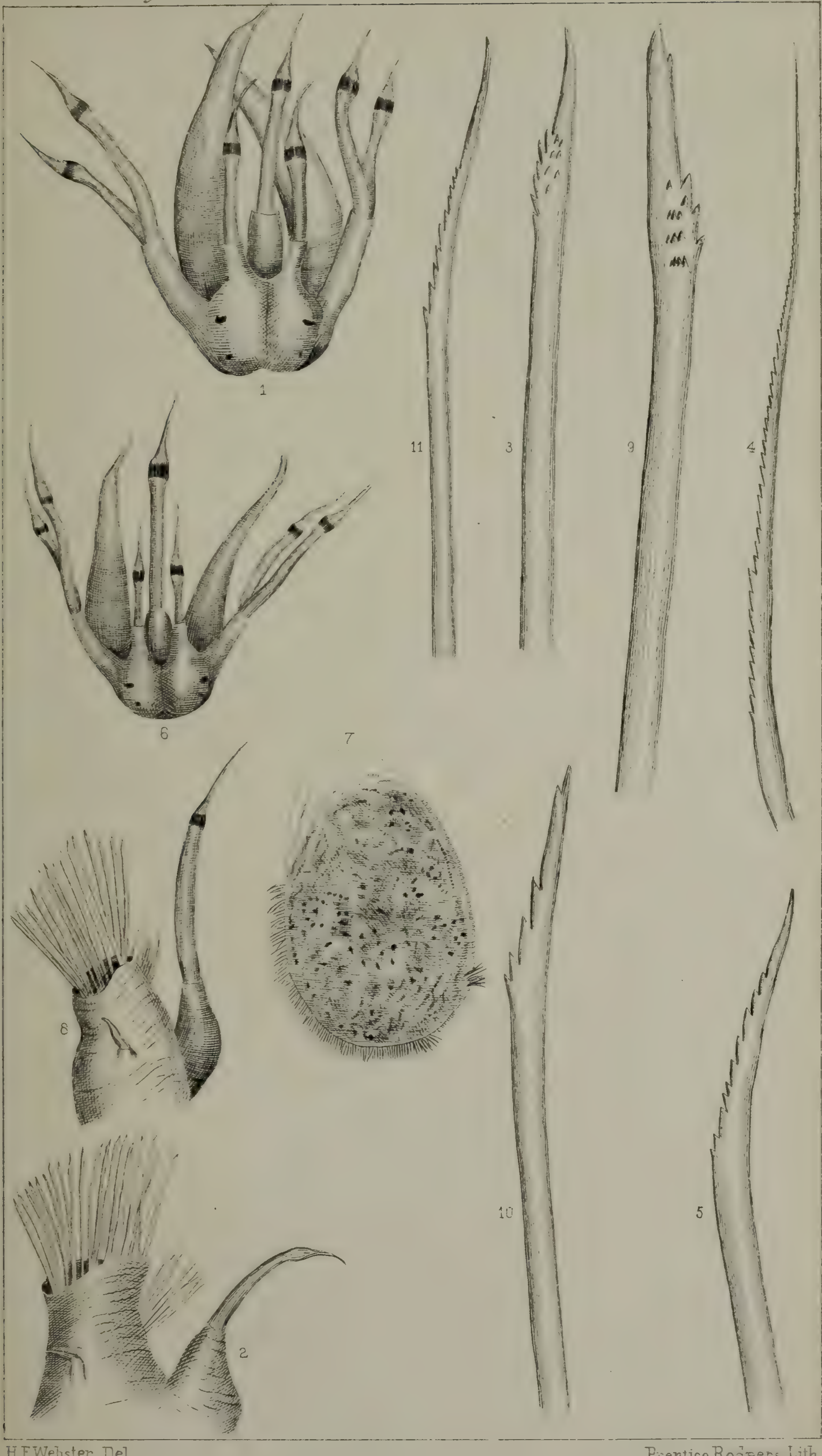
Fig. 6. Head of a small specimen, × 25.
Fig. 7. Elytron from middle of body, × 15.
Fig. 8. Foot from a larger specimen, × 25.
Figs. 9, 10. Setæ of lower ramus, × 140.
Fig. 11. Seta of first segment, lower ramus, × 140.



H. E. Webster, Del. Prentice Rodgers, Lith.

EXPLANATION OF PLATE II.

LEPIDONOTUS VARIABILIS *n. sp.*

Page 205.

Fig. 12. Seta of dorsal ramus, × 410.

Fig. 13. Seta of ventral ramus, worn, × 140.

Fig. 14. Head of ? sexual form, × 25.

ANTINOË PARASITICA *n. sp.*

Page 208.

Fig. 15. Head, enlarged.

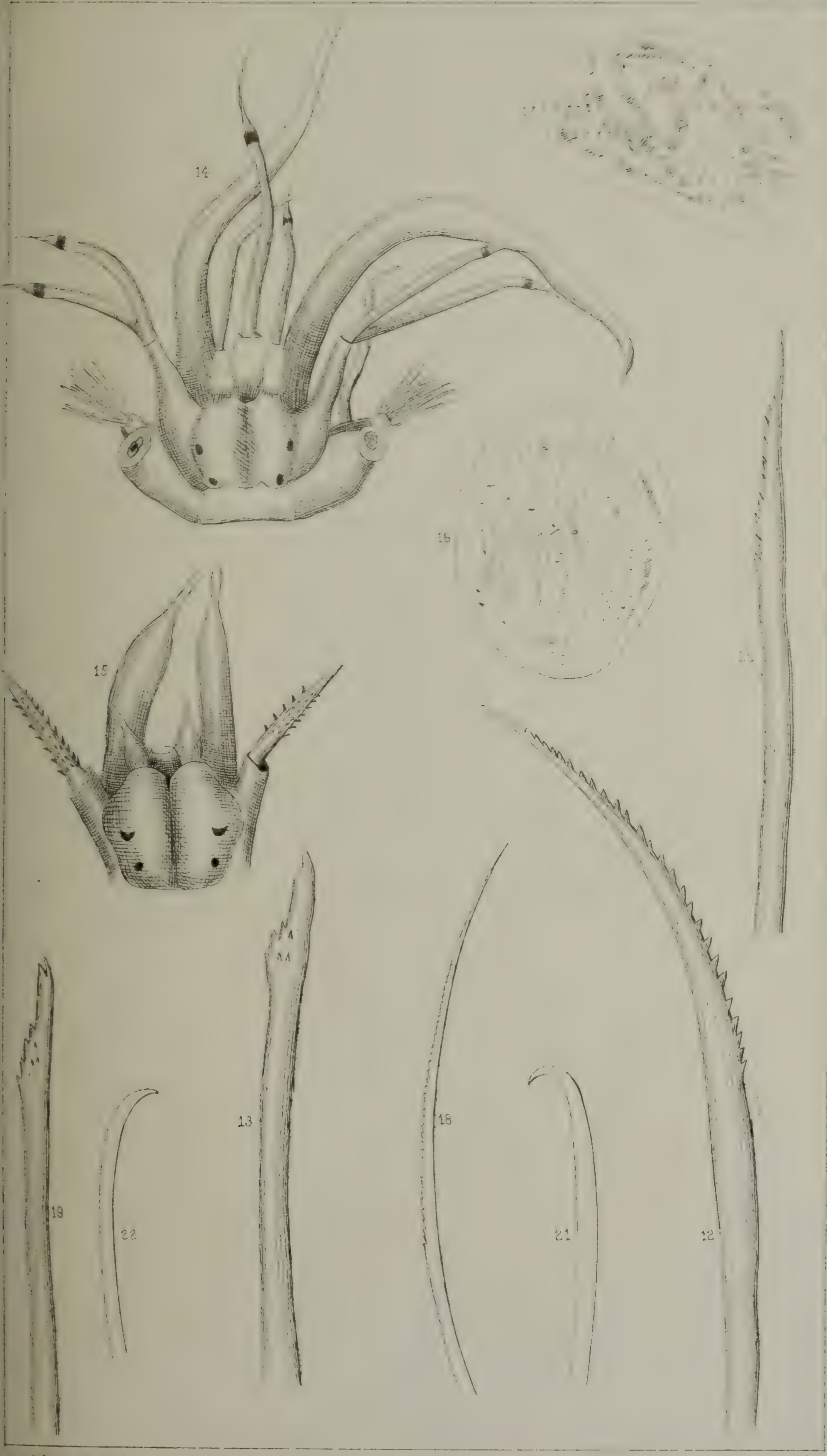
Figs. 16, 17. Elytra, × 35.

Fig. 18. Seta of dorsal ramus, × 460.

Fig. 19. Seta of ventral ramus, × 410.

Fig. 20. Seta of ventral ramus, first two segments, × 460.

Figs. 21, 22. Hooked setæ of last two segments, × 410.



Del. Prentice Rodgers, Lith.

EXPLANATION OF PLATE III.

LEPIDAMETRIA COMMENSALIS *n. sp.*

Page 210.

Fig. 23. Head, × 25.
Fig. 24. Jaw piece, × 25.
Fig. 25. Emarginate elytron, × 5.
Fig. 26. Oval elytron, × 5.
Fig. 27. Posterior elytron, × 5.
Fig. 28. Foot, × 25.
Fig. 29. Large pointed seta, × 70.
Fig. 30. Bidentate seta of lower ramus, × 140.
Fig. 31. Seta of dorsal ramus, × 240.

PHYLLODICE FRAGILIS *n. sp*

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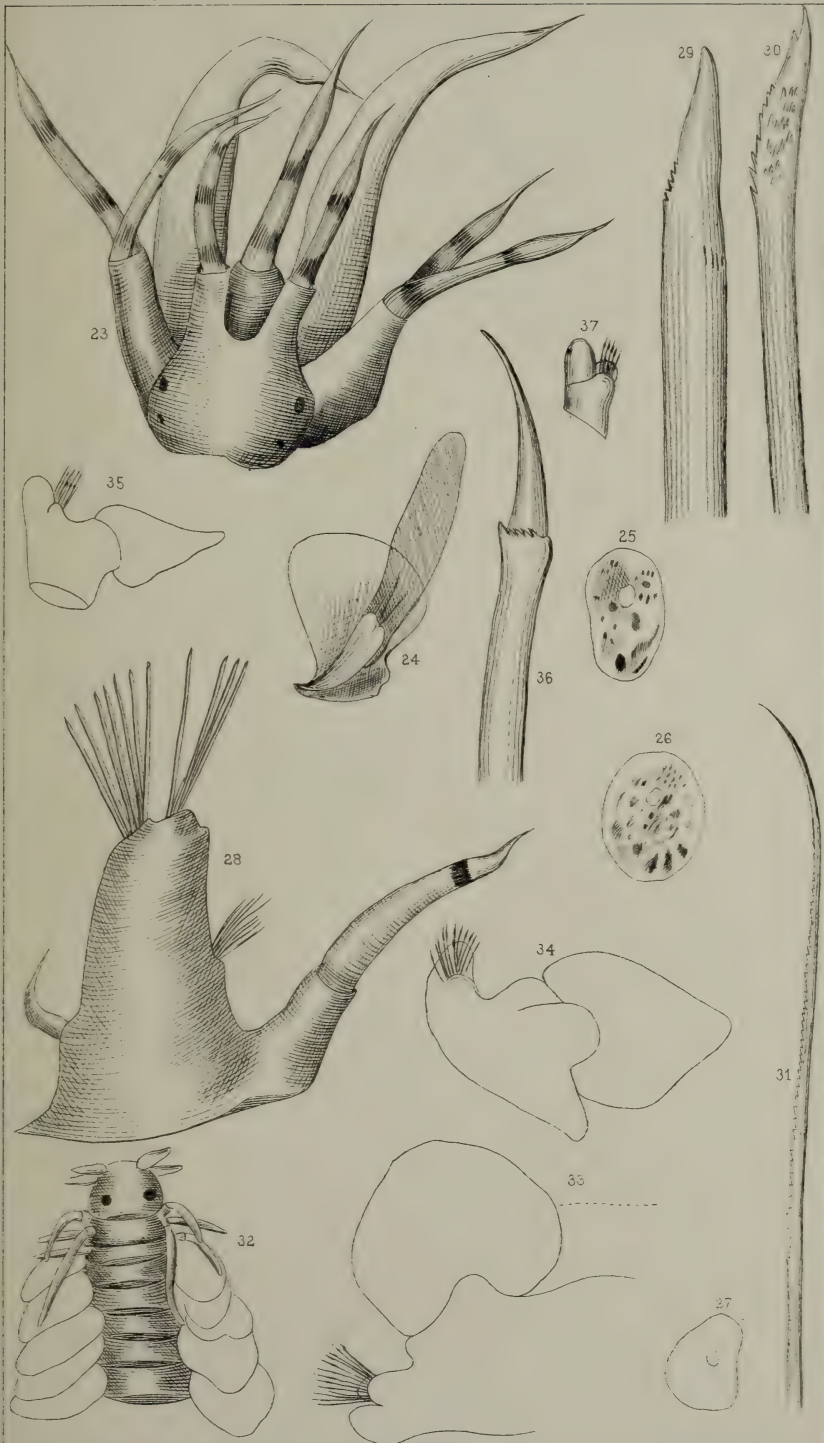
Fig. 32. Head and anterior segments, × 35.
Fig. 33. Foot from anterior third, × 30.
Fig. 34. Foot from posterior third, × 30.
Fig. 35. Foot from a young specimen, × 30.
Fig. 36. Seta, × 750.
Fig. 37. Foot with ventral cirrus, × 30.



H. E. Webster, Del.

Prentice Rodgers, Lith.

EXPLANATION OF PLATE IV.

EUMIDA MACULOSA *n. sp.*

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Fig. 38. Head, etc., × 70.
Fig. 39. Anterior foot, × 70.
Fig. 40. Foot from middle third, × 70.
Fig. 41. Posterior dorsal cirrus from a large specimen, × 70.

SYLLIS FRAGILIS *n. sp.*

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Fig. 42. Seta, × 750.
Fig. 43. Acicula, × 750.

(Fig. 43 is not good, the terminal button not being shown.)

SPHÆROSYLLIS FORTUITA *n. sp.*

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Fig. 44. Head and anterior segments, × 130.
Fig. 45. Posterior segments, × 130.
Fig. 46. Compound seta with long appendix, × 750.
Fig. 47. Compound seta with short appendix, × 750.
Fig. 48. Simple seta, × 750.

PÆDOPHYLAX DISPAR *n. sp.*

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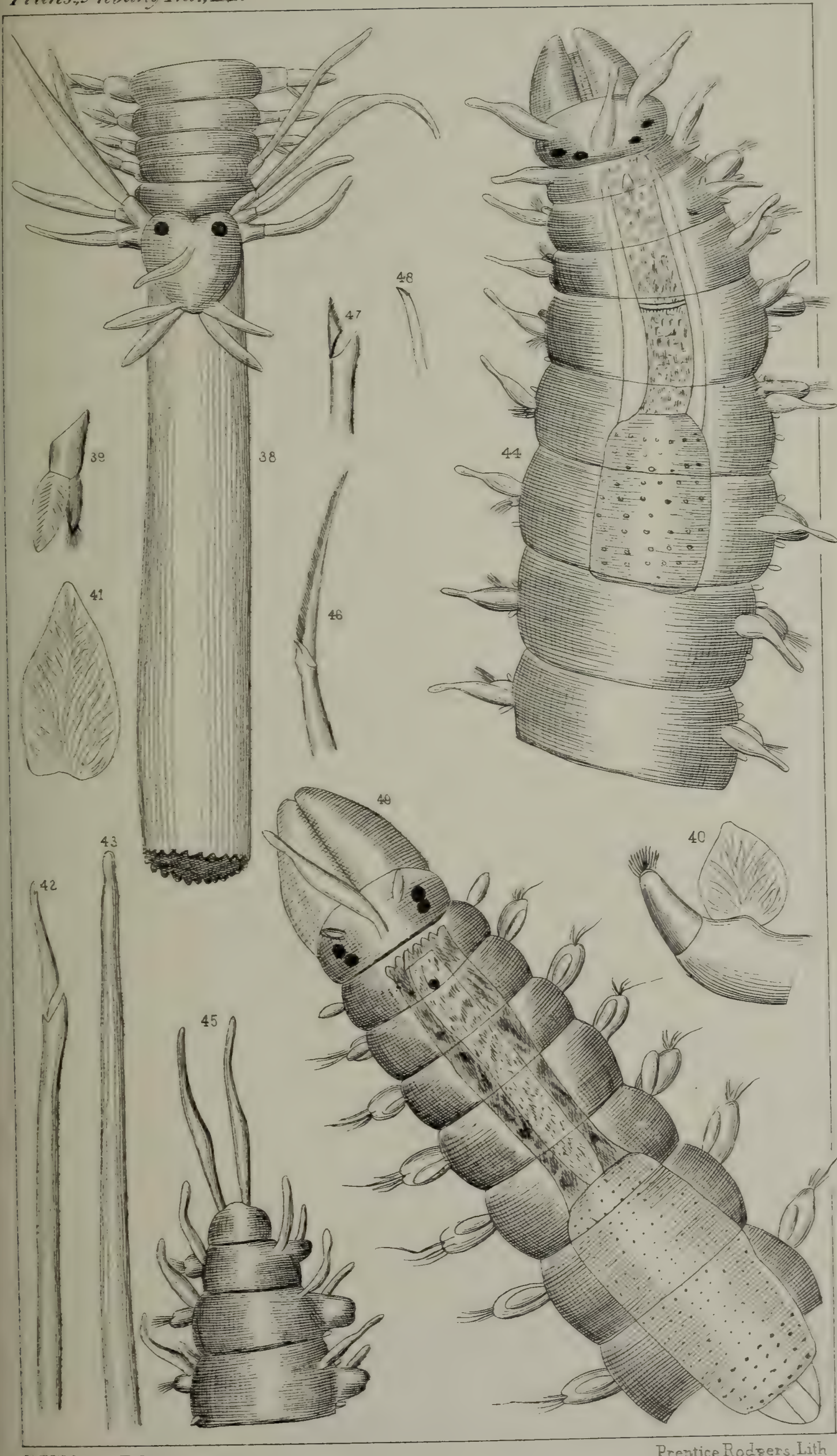
Fig. 49. Head and anterior segments, × 130.



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EXPLANATION OF PLATE V.

PÆDOPHYLAX DISPAR, *n. sp.*

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Fig. 50. Posterior segments, × 130.
Fig. 51. Seta with short appendix, × 750.
Fig. 52. Seta with longer capillary appendix, × 750.
Fig. 53. Same as 52, different view, × 750.
Fig. 54. Simple seta, slightly curved, × 750.
Fig. 55. Simple seta, more curved, × 750.

NEREIS IRRITABILIS *n. sp.*

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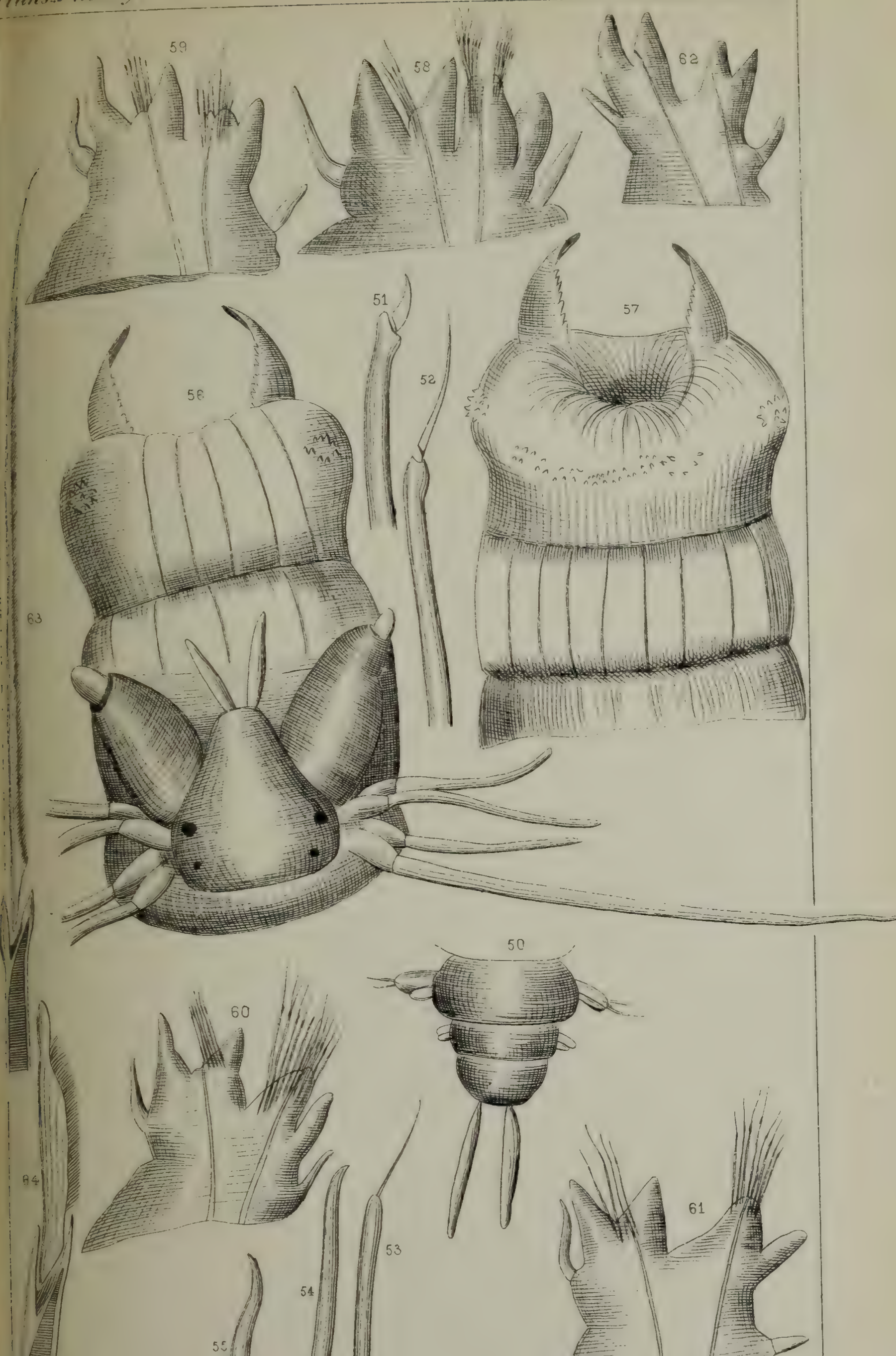
Fig. 56. Head and extended proboscis, × 20.
Fig. 57. Proboscis, ventral view, × 20.
Fig. 58. Foot from 7th segment, × 20.
Fig. 59. Foot from 30th segment, × 20.
Fig. 60. Foot from 50th segment, × 20.
Fig. 61. Foot from 70th segment, × 20.
Fig. 62. Foot from 160th segment, × 20.
Figs. 63, 64. Setæ, × 450.



V. H. Webster, Del.   Prentice Rodgers, Lith.

EXPLANATION OF PLATE VI.

NEREIS IRRITABILIS *n. sp.*

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Fig. 65. Adult female, foot from 70th segment, × 20.
Fig. 66. Sexual seta, × 230.
Fig. 67. Adult male, foot from 70th segment, × 20.
Fig. 68. Adult male, 7th dorsal cirrus, × 20.
Fig. 69. Adult male, 8th dorsal cirrus, × 20.

NEREIS LIMBATA *Ehlers.*

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Fig. 70. Asexual form, posterior segments, × 70.
Fig. 71. Sexual form, posterior segments, × 70.
Fig. 72. Female, foot from 10th segment, × 20.
Fig. 73. Female, foot from 20th segment, × 20.
Fig. 74. Female, foot from 50th segment, × 20.
Fig. 75. Female, foot from 70th segment, × 20.

MARPHYSA SANGUINEA *Quatr.*

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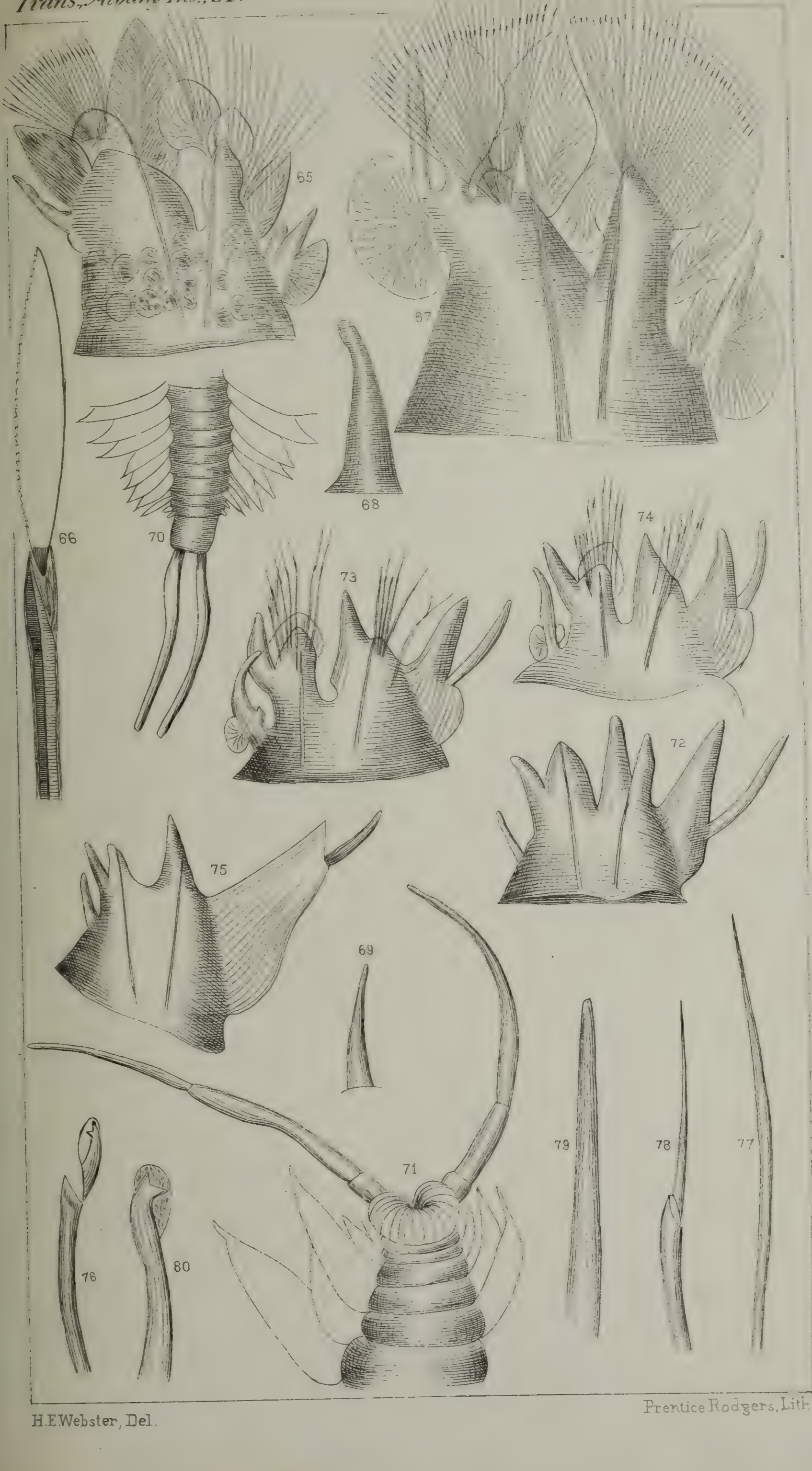
Fig. 76. Compound bidentate seta, not found in adult, × 450.
Fig. 77. Simple seta, few in young, numerous in adult, × 450.
Fig. 78. Compound seta, few in young, many in adult, × 400.
Fig. 79. Acicula of upper bundle of setæ, × 450.
Fig. 80. Acicula of lower bundle, × 450.



H. E. Webster, Del. Prentice Rodgers, Lith.

EXPLANATION OF PLATE VII.

MARPHYSA SANGUINEA *Quatr.*

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Fig. 81. Series (c). Head and anterior segment, × 70.

Fig. 82. Series (d). Head with short lateral antennæ, × 25.

Fig. 83. Series (d). Head, × 35.

DRILONEREIS LONGA *n. sp.*

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Fig. 84. Foot from middle of body, × 70.

Fig. 85. Outline of feet from posterior third of the body, × 70.

Fig. 86. Posterior foot, × 70.

Fig. 87. Setæ, × 230.

Fig. 88. Jaw pieces, enlarged.

STAUROCEPHALUS SOCIABILIS *n. sp*

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Figs. 89, 90, 91. Setæ, × 750.

TROPHONIA ARENOSA *n. sp.*

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Fig. 92. Transverse section of 16th segment, × 15.

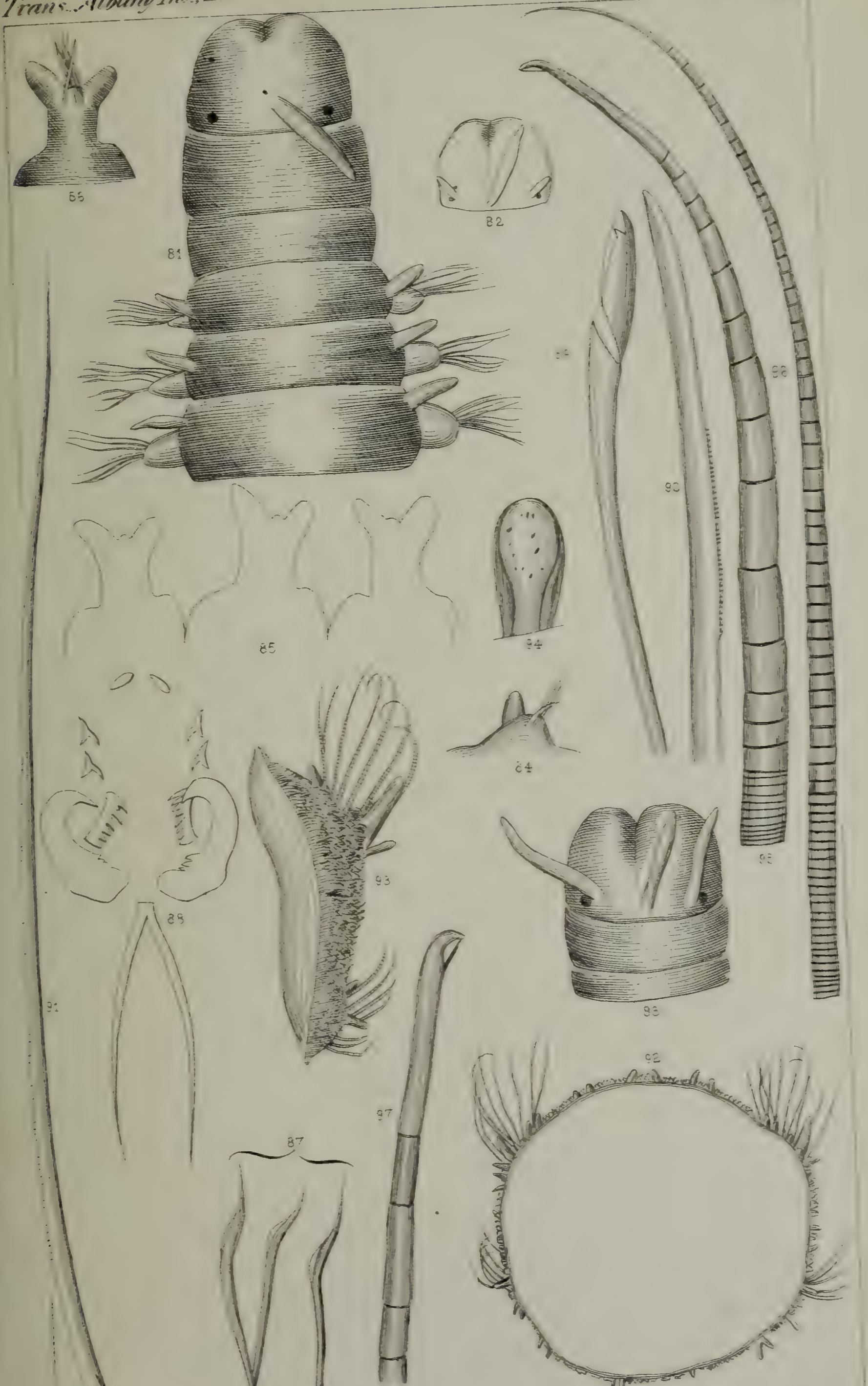
Fig. 93. Part of same segment, enlarged.

Fig. 94. Dorsal papilla, × 130.

Fig. 95. Dorsal seta from 16th segment, × 130.

Fig. 96. Ventral seta from 16th segment, × 130.

Fig. 97. Posterior ventral seta, × 130.



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Prentice Rodgers Lith.

EXPLANATION OF PLATE VIII.

SPIOCHÆTOPTERUS OCULATUS *n. sp.*

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Fig. 98. Head and buccal segment, × 70.
Fig. 99. Dorsal ramus from middle region, × 70.
Fig. 100. Dorsal ramus from posterior region, × 70.
Fig. 101, a, b, c, d. Setæ from anterior region, × 230.
Fig. 102. Peculiar seta of 4th setigerous segment, × 130.

NERINE HETEROPODA *n. sp.*

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Fig. 103. Head and anterior segments, × 15.
Fig. 104. Foot from 7th segment, × 20.
Fig. 105. Foot from 21st segment, × 20.
Fig. 106. Foot from 25th segment, × 20.
Fig. 107. Foot from 35th segment, × 20.
Fig. 108. Seta, dorsal and anterior ventral, × 235.
Fig. 109. Ventral seta, behind the 25th segment, × 235.
Fig. 110. Seta with single margin, posterior ventral rami, × 235.

POLYDORA HAMATA *n. sp.*

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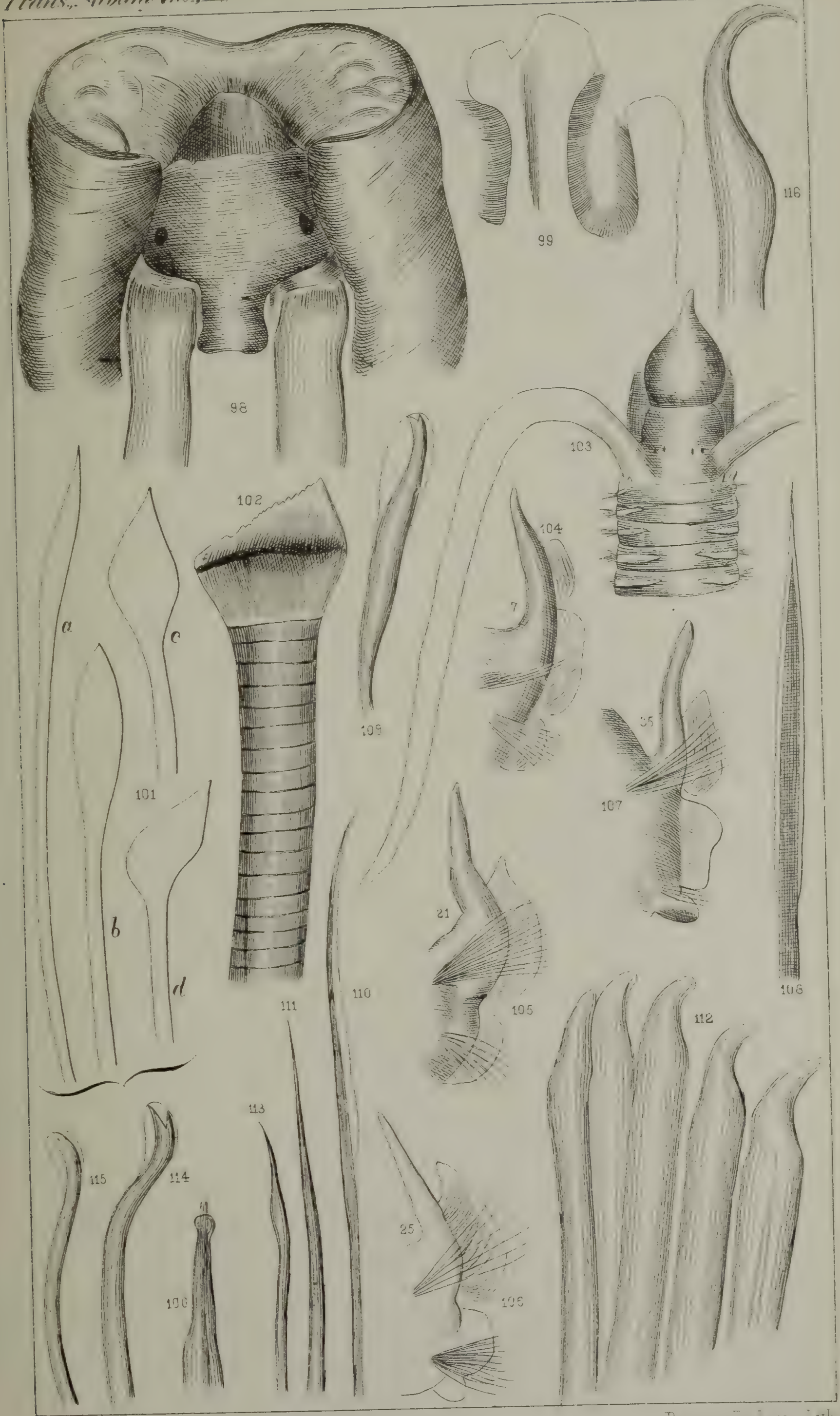
Fig. 111. Capillary seta, dorsal, and anterior ventral rami, × 450.
Fig. 112. Setæ of 5th segment, upper series, × 450.
Fig. 113. Seta sometimes found in lower series 5th segment, × 450
Fig. 114. Anterior ventral seta, × 450.
Fig. 115. Posterior ventral seta, × 450.
Fig. 116. Dorsal hook of posterior segments, × 230.



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EXPLANATION OF PLATE IX.

POLYDORA HAMATA *n. sp.*

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Fig. 117. Long seta of posterior segments, × 450.

Fig. 118. Anal plates, × 25.

POLYDORA CÆCA *n. sp.*

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Fig. 119. Long dorsal seta, × 450.

Fig. 120. Short dorsal seta, × 450.

Fig. 121. Setæ of 5th segment, × 230.

Fig. 122. Bidentate ventral seta, × 450.

ARICIA RUBRA *n. sp.*

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Fig. 123. Anterior ventral setæ, × 450.

Fig. 124. Long ventral seta, × 450.

Fig. 125. Transverse section of anterior segment, × 20.

Fig. 126. Transverse section of posterior segment, × 20.

ARICIDEA FRAGILIS *n. sp.*

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Fig. 127. Head and anterior segments, × 40.

Fig. 128. Transverse section of anterior segment, magnified.

Fig. 129. Transverse section of posterior branchiated segment, magnified.

Fig. 130. Transverse section of non-branchiated segment, magnified.

Fig. 131. Dorsal seta, × 450.

Fig. 132, a, b. Ventral setæ, × 450.

SABELLARIA VARIANS *n. sp.*

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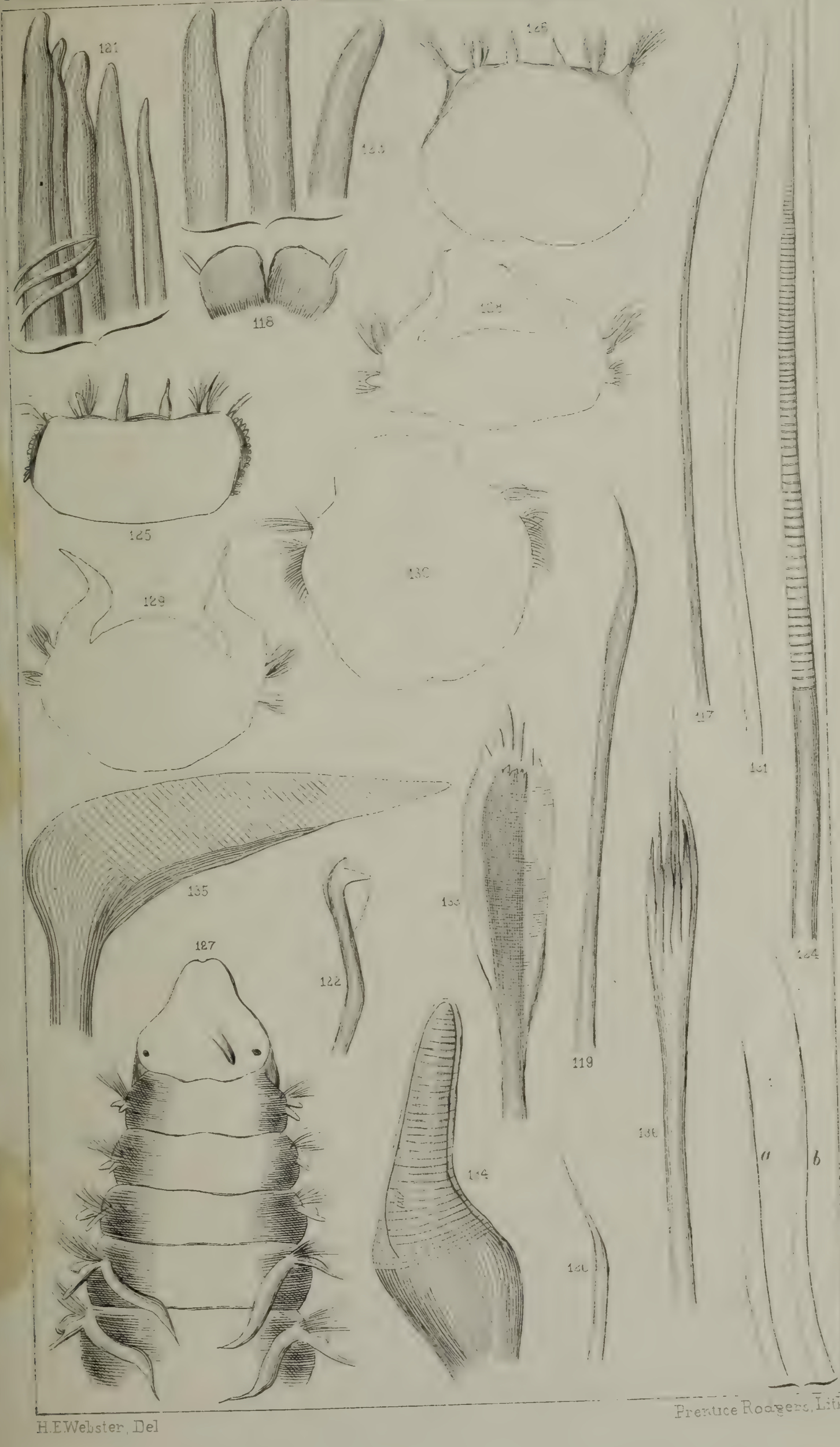
Fig. 133. Opercular seta of outer series, × 70.

Fig. 134. Opercular seta of middle series, × 70.

Fig. 135. Opercular seta of inner series, × 70.

Fig. 136. Dorsal seta of 3d segment, × 230.

Plate IX.



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EXPLANATION OF PLATE X.

Sabellaria varians *n. sp.*

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Fig. 137. Dorsal seta of 4th and 5th segments, × 230.
Fig. 138. Dorsal uncinus, × 450.
Fig. 139. Ventral seta, outer half, × 450.

Pectinaria (Lagis) dubia *n. sp.*

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Fig. 140. Paleola, × 70.
Fig. 141. Dorsal seta, outer half, × 450.
Fig. 142. Geniculate dorsal seta, outer third, × 450.
Fig. 143. Ventral uncinus, × 450.
Fig. 144. Spinulæ of the scapha, × 230.

Melinna maculata *n. sp.*

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Fig. 145. Uncinus, × 450.
Fig. 146. Capillary seta, × 230.
Fig. 147. Spinula, × 130.

Lysilla alba *n. sp.*

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Fig. 148. Seta, × 750.

Potamilla tortuosa *n. sp.*

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Fig. 149. Long capillary seta from anterior segment, × 450.
Fig. 150. Short capillary seta from anterior segment, × 450.
Figs. 151, 152. Uncini from anterior segment, × 450.
Fig. 153. Capillary seta from posterior segment, × 450.

Cabira incerta *n. sp.*

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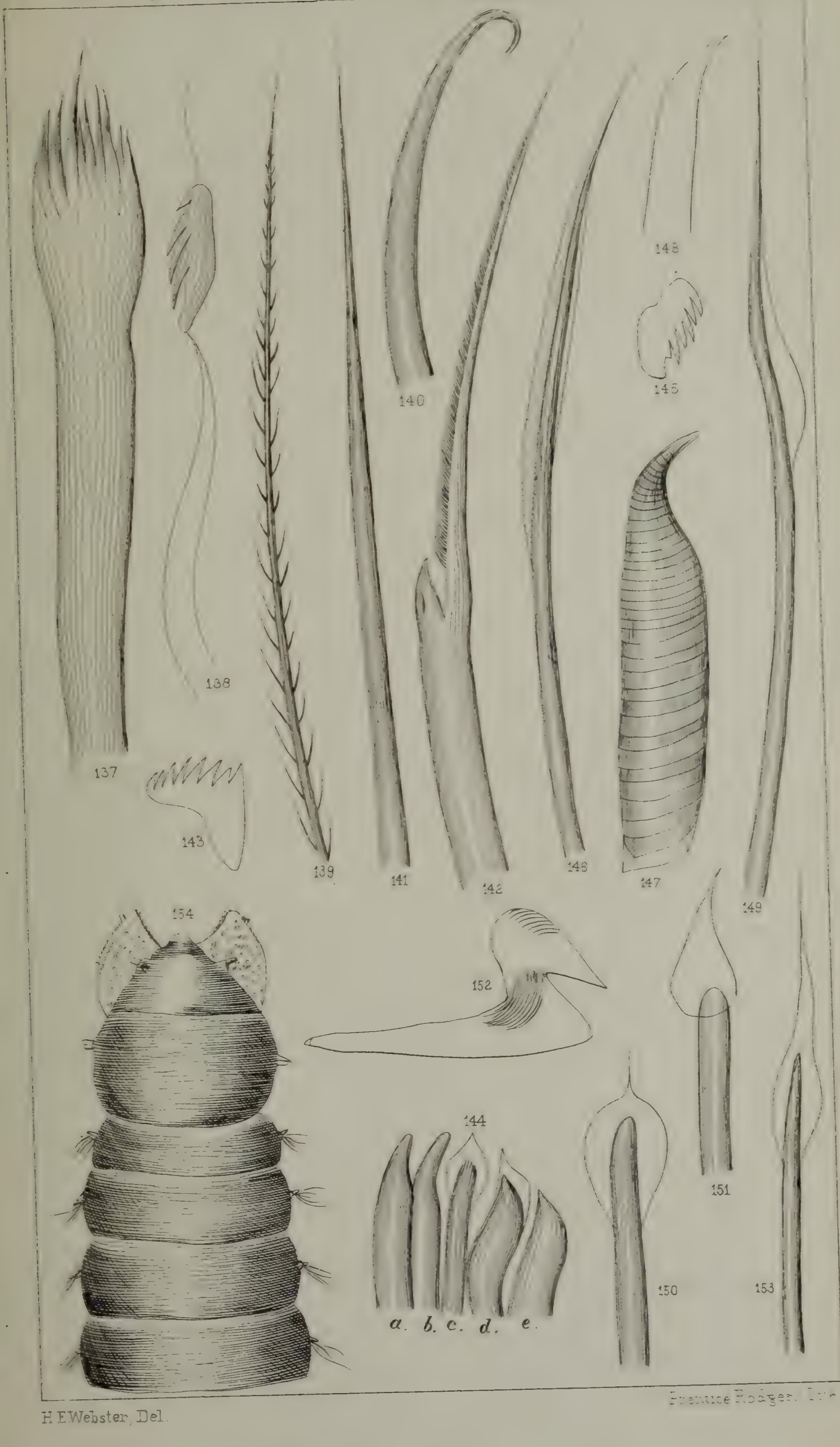
Fig. 154. Head and anterior segments, dorsal view, × 70.



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EXPLANATION OF PLATE XI.

CABIRA INCERTA *n. sp.*

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Fig. 155. Head and anterior segments, ventral view, × 70.
Fig. 156. Ventral hook, × 230.
Fig. 157, a, b. Dorsal setæ, × 450.

PHRONIA TARDIGRADA *n. sp.*

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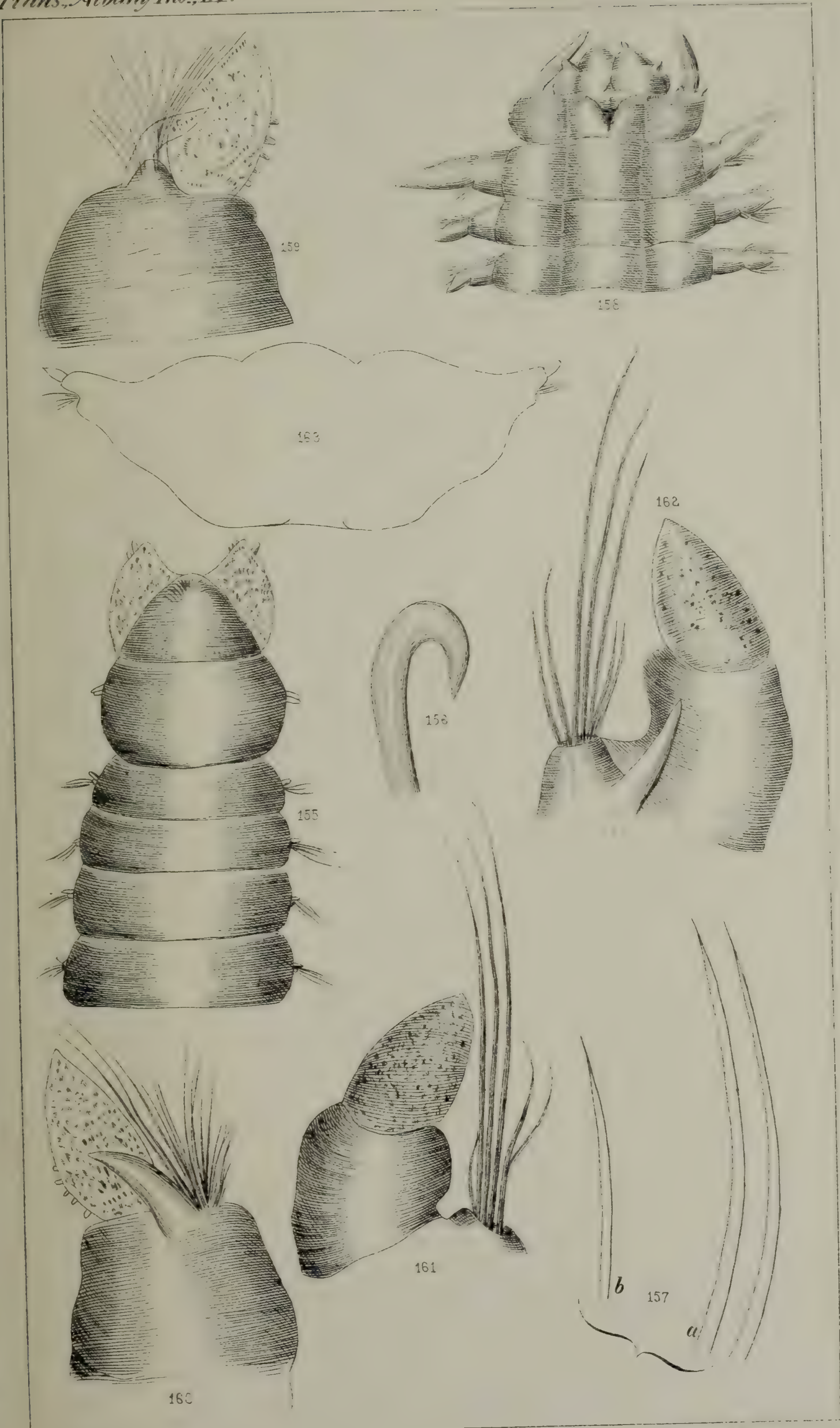
Fig. 158. Head and anterior segments, dorsal view, × 40.
Fig. 159. Foot from 6th segment, dorsal view, × 115.
Fig. 160. Foot from 6th segment, ventral view, × 115.
Fig. 161. Foot from 300th segment, dorsal view, × 115.
Fig. 162. Foot from 300th segment, ventral view, × 115.
Fig. 163. Transverse section taken at the 300th segment, × 20.



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