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"Utilization of Water Power at Niagara Falls."

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UTILIZATION
OF
WATER POWER
AT
NIAGARA FALLS.

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Assoc. Mem. Am. Soc. C. E.

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BUFFALO SOCIETY OF NATURAL SCIENCES.

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Utilization of Water Power at Niagara Falls.

Few branches of Engineering show more clearly the rapid progress of the age in which we live than the advancement made during the past fifteen years in the art of water power development. Nearly all of us can remember the time when the word "water-wheel" was associated in our minds with the rustic grist mill with its stagnant pond, its moss covered shingles, and its slowly revolving overshot wheel. Such mills seemed to have come to us as a legacy of the past. They had no place in the strenuous, hurrying life of the age of steam. It is no wonder that they formed a favorite subject for the artist who wished to depict an idyllic scene or a common theme for the pastoral poet. The dull, monotonous rumble of the grindstones, the groaning of the wooden shaft come back to us from our childhood days with the picture of the sleeping miller, of cattle standing knee deep in water and all the myriad sights and sounds of a drowsy August day. Little did we think then that in a few years the utilization of the power of falling water would form such a chapter in our national development and in the history of our material prosperity. It seemed that except in isolated cases water power development was doomed to be left far behind in the race with steam. But what a wondrous change has now appeared. Every water-fall in settled communities is carefully examined, companies are formed to develop its power, vast capital is invested and some of the best engineering talent in the country is employed in its utilization. Such is the result of the past decade and yet the work is only begun.

What has caused this wondrous change? What mighty magician has wrought this transformation? The question may be answered in one word,—"Electricity." Thinking scientists had long deplored the decadence of water power and had carefully investigated its causes. They found that it was largely due to the fact that water-falls were usually situated at inconvenient loca-

tions, far removed from the centers of population and without proper facilities for the transportation of raw materials or finished products. They had therefore reached the conclusion that the crying need was the transmission of the power developed by water wheels, and rope drives, compressed air, water under high pressure and other forms of power transmission were in turn experimented with but each was found to have its limitations, and it is only in the past few years that electrical engineering with its wonderful discoveries has practically solved the problem and made available at the factory the power of the distant stream. Hence water falls that a few years ago were considered only as obstructions to navigation are now of great value. The very language shows the effect of the change. A few years ago we spoke of water-falls, now we speak of water powers.

A few figures may be interesting in this connection. According to Census Bulletin No. 247 the water power used in manufactures in 1880 equalled 1,225,000 H. P.; in 1890 1,263,000 H. P.; in 1900 1,727,000 H. P.; the increase from 1880 to 1890 being 3.1%, while from 1890 to 1900 the increase was 36.7%. The figures for 1900 do not include water power employed for generating electricity used in manufactures, which would probably add 200,000 H. P. to the amount of water power above mentioned, thus making the increase for the last decade of the 19th century not less than 50%. During the same period the amount of water power developed in the State of New York was practically doubled.

Of all the water power developments that marked the close of the last century none was on so large a scale, none has attracted such world-wide interest, and none is of such importance to citizens of Buffalo and its vicinity as the utilization of the power of Niagara Falls. It is true that the power of this river was used as early as 1725 when the settlers operated a saw mill on the rapids above the Falls, but it was not until after the year 1890 that power development at Niagara assumed more than a local interest. With the success of electrical generation and transmission there commenced a new phase in the history of industrial Niagara and it is with this later form of power utilization that we are concerned tonight.

There is of course nothing new in the idea of utilizing Niagara's energy. Every man of a mechanical turn of mind who ever contemplated the resistless force of its falling water has been impressed with the fact that vast industrial progress would result from the diversion of even a small proportion of this power into useful chan-

nels. Among those who many years ago felt the mighty power of the falling waters and contemplated the results of using it to produce useful mechanical power was the famous Dr. Siemens, who in a lecture delivered in 1877 before the Iron and Steel Institute of Great Britain referred to his impressions of Niagara and stated that all the coal raised at that time throughout the entire world would be required to produce energy equal to that produced by the falls alone, without considering the force of the rapids. This statement may have been somewhat exaggerated but the following figures are believed to be accurate. The total difference in level of Lakes Erie and Ontario is 328 feet. The minimum flow in the Niagara River, as observed by the government engineers is 178,000 cubic feet per second. The total energy represented by this amount of water in passing from one lake to the other therefore equals 6,635,000 H. P. or in passing from the upper river above the rapids to a point above the lower rapids equals 4,380,000 H. P. But such figures are like those representing the capital of the steel trust, (although this is not entirely a "water" power), or the distance to the nearest fixed star—they convey but little meaning. But take, as an example, the energy produced by a single cubic foot of water per second in dropping from the upper river to a point below the falls, which is 25 H. P. That does not seem a large amount in these days of large numbers, but what does it represent? A force sufficient to raise a one pound weight 2½ miles in one second, to raise a large sized passenger locomotive to the height of a man's head in one minute, or to raise an audience of 500 people from the floor to the ceiling of an ordinary room in one minute. And this is done by a bucket of water. Perhaps this may give us some idea of the power that has carved the history of the ages on the rocky walls of Niagara's gorge.

To utilize a portion of this enormous power four great companies are now at work and a fifth is about to commence operations. It is the object of our talk to-night to give a brief outline of the plans of each of these companies and to call your attention to such points in their several plans of development as may be of special interest.

The first company to engage in the development and sale of power on a large scale was the Niagara Falls Hydraulic Power and Manufacturing Co. The plan under which this company is working was outlined by Augustus Porter of Niagara Falls in 1847. Previous to that time a few water wheels had been operated from a canal above the falls and a paper mill had been built on Bath Island, but Mr. Porter sought for some method of development

that would not mar the scenic features of the falls and therefore proposed that a canal should be cut from the upper river, just above the rapids, to a point on the top of the high bank of the river below the falls, the water from such canal to be discharged into the lower river after operating wheels set below the level of the ground surface. The almost level surface of the ground between the points of entry and discharge and the substantial character of the rock through which it would pass made the project an ideal one. Nevertheless Mr. Porter failed to interest capital in this project and it was not until after his death that work was commenced. Even then the excavation of the canal was carried on intermittently by various parties until in 1861 Horace H. Day completed a canal 4,400 feet long, 36 feet wide and 8 feet deep. At the lower end of this canal was constructed a basin or forebay, parallel with the face of the cliff and about 350 feet from it, the present size of this basin being 70 feet by 600 feet although it was, of course, much smaller at first. Even then the opportunities of the power do not appear to have been appreciated and it was not until 1870 that the first mill was built to use water from this canal. In 1877 the canal and the property and rights belonging thereto were purchased by Mr. Jacob F. Schoellkopf and Mr. A. Chesborough who organized the present company. The number of mills utilizing this source of power has steadily increased until at the present time the various industries in the lower milling district (so called) develop about 7,500 H. P. including that in use in the lower mill of the Cliff Paper Co. Most of these factories have constructed their own wheelpits and installed their own wheels.

A good indication of the progress made in hydraulic development in the last few years is the fact that the original grants of the Hydraulic Power and Manufacturing Co. did not include the slope of the bank between the bottom of the vertical cliff and the edge of the lower river, giving a right to excavate only 100 feet below the top of the bank, as it was considered that wheels would never be constructed to operate under a greater head than this, and it was not until 1886 that the Hydraulic Co. secured deeds for this lower slope. As a matter of fact none of the mills thus far mentioned utilized a head of more than 50 or 60 feet and many of them used a still lower fall. The consequence is that an engineer when looking at the cliff below these mills and seeing the large amount of water falling from the outlets of the various wheelpits is impressed with the vast amount of power going to waste. At least 10,000 H. P. is thus lost, or enough to supply all the industries of many a good sized city.

In 1881 the Niagara Falls Hydraulic Power and Manufacturing Co. installed their first plant for supplying power. This consisted of a shaft 20 feet by 40 feet sunk to a depth of 80 feet, 200 feet back from the edge of the cliff, a discharge tunnel being carried from the bottom of this slot to the face of the high bank. Water from the canal was led through iron penstocks to two wheels located in this pit. These wheels have vertical axes, one being of 1,000 H. P. and one of 500 H. P., the head employed being 75 feet. The power from these wheels is transmitted to customers by rope drives and belting, the length of such transmission being inconsiderable. A third wheel with a capacity of 600 H. P. with horizontal shaft has since been placed in this wheelpit.

In 1892 the Niagara Falls Hydraulic Power and Manufacturing Co. commenced to enlarge their canal to a width of 70 feet and a depth of 14 feet. In the same year a change was made in the plan of development and a system inaugurated which was in many respects similar to that now employed. The Cliff Paper Mill desired additional power for grinding pulp and as the capacity of the original canal was exhausted and they were not willing to wait for the completion of the canal extension, it was determined to use the discharge water from the wheels then installed in the wheelpit above described. Accordingly a new tunnel was driven from the face of the cliff to connect with the bottom of the wheelpit and the discharge water was thus led to a steel penstock 8 feet in diameter laid on the same slope as the talus. In case sufficient water is not discharged from the upper wheels an arrangement is provided for admitting water from the basin directly into the upper tail race. The loose rock was cleared from the top of a layer of red sandstone lying just above the water of the lower river. On this surface was built a two-story pulp mill, the lower story containing four water wheels having a total capacity of 2,500 H. P. These wheels are fed from a ten foot receiver connected with the penstock. Three of these are directly connected with the wood grinders and one wheel is used to drive a generator operating the paper making machines in the upper mill. This was one of the first, if not the first instance of electricity being used for operating paper making machinery. The wheels operate under a head of 125 feet, are 66″ in diameter and are of the inward flow type on horizontal axes. Like all the turbines used by the Hydraulic Power and Manufacturing Company, these wheels are of American design. An inclined conveyor is used for transportation of men and materials between the upper and lower works.

The plant for the Cliff Paper Co. was the fore-runner of the present electrical power plant of the Hydraulic Co. As soon as the company saw that electrical generation and transmission was an assured success and that Niagara Falls was destined to become one of the great electro chemical centers a line of pipe was laid from the basin to the edge of the lower river and water under a head of 210 feet thrown from a giant nozzle or "Monitor" commenced to wash away the rock that for ages had fallen from the bank above to the shores of the gorge below. A level strata near the waters edge was cleared, the fallen boulders were used for masonry and a power house 100 feet wide was built immediately below the old mills, being located a short distance above the upper steel arch bridge. To this power house water was led from the basin above in a steel penstock 11 feet in diameter. Successive additions have been made to this power house and two more penstocks have been added, one 11 feet in diameter and one 8 feet in diameter. The canal has been excavated to a width of 100 feet and a depth of 18 feet until it has a capacity of about 100,000 H. P. at a velocity of 4 feet per second. The power house below the bank now contains the following turbine wheels, viz:—3 of 1650 H. P.; 1 of 1900 H. P.; 4 of 2300 H. P.; 1 of 2800 H. P.; and 5 of 2900 H. P. An exciter wheel of 250 H. P. is about to be installed. Your attention is called to the fact that these wheels operate under a head of 210 feet, one of the highest heads used in the East on turbine wheels. Each wheel is of the outward flow type with horizontal shafts. Water from the penstocks enters steel receivers placed beneath the floor and thence to the wheels through 60″ pipes controlled by hydraulically operated gate valves. The supply pipes enter the bottom of each wheel case at the center and the water is discharged through two draft tubes, one on each side. The level of the tail race into which the draft tubes discharge is maintained several feet above the average level of the lower river so that the wheels are said to work under a practically constant head. Two dynamos are directly coupled to each wheel 4 of these being direct current machines and 24 alternating current machines. Two 11,000 volt alternators and an exciter dynamo will be installed in April. The voltage of most of the dynamos is very low, the current being transmitted to the top of the bank only through copper and aluminum bars and cables. The plant therefore presents at present no interesting problems in transmission of power, but the 11,000 volt dynamos are for transmission of power to the new factory district at the north end of the city of Niagara Falls.

From the above details a figure to be carried away with you to-night is that the wheels now installed by the Hydraulic Power and Manufacturing Co. and its customers have a total capacity of 38,000 H. P., an amount approximately equal to the total power at Holyoke. Very important is the announcement that a new power house with a capacity of 50,000 H. P. is about to be commenced. This power house will contain high voltage dynamos and will be used for supplying new industries in the district just mentioned. Niagara Falls will then contain three great factory districts using an amount of electrical power far exceeding that of any city in the world which employs water as its motive force.

In the year 1885 there came to Niagara Falls in the course of his professional services for the State of New York an engineer whose name should ever be remembered by those interested in the commercial prosperity of the Niagara Frontier, Thomas Evershed, the man with the idea. Engaged in plans to prevent the spoilation of one of the most sublime of nature's spectacles, he saw that such plans were not inconsistent with the utilization of a part of the enormous power represented by Niagara's falling waters. He believed that by driving a tunnel from the lower river to a point above the mouth of the Hydraulic Power Company's canal such tunnel could be used for the discharge of water from the upper river after it had done its work in the generation of power. This idea of a discharge tunnel was not entirely a new one, as it had previously been employed at St. Anthony's Falls on the Mississippi, but the application of this principle to Niagara had apparently never been suggested until it was advocated by Mr. Evershed. Having the courage of his convictions he soon interested local business men in his scheme and a company of eight was formed which on March 31st, 1886, obtained from the State of New York a special charter which permitted the diversion of sufficient water from the upper river to generate 250,000 H. P. On June 1st, 1886, Mr. Evershed issued his first formal plan and estimate to which the attention of capitalists was soon attracted and in 1889 was formed a strong combination of men whose financial reputation was world-wide. They organized the Cataract Construction Co. to build the plant of the Niagara Falls Power Co., the parent Co. The Cataract Construction Co has now practically gone out of business, the investors who formerly composed it having acquired a controlling interest in The Niagara Power Co. and continuing operations in its name. The plant of this company, especially in its earlier stages, has been so fully described in both the engineering press

and in the local papers that its principal features are familiar to you all and it is the intention of the present lecture to call attention to only the more unusual or interesting of its details with such a brief description of its general plans as may be necessary to an understanding of such details.

In the first place consider the main conception,—a tunnel 1¼ miles long, 200 feet beneath the surface, with an area of 335 square feet, designed to carry water at the rate of 29 feet per second, an aqueduct such as was never before built in the history of man—a conception such as could come only to a man with an imagination, an imagination touched by the inspiration of the great cataract within whose sound he had toiled so long. Its immensity may impress us more when we think that when running to its designed capacity such a tunnel will carry enough water in one minute to supply a city of 10,000 inhabitants with drinking water for a year and a quarter.

Mr. Evershed's plan was no sooner formulated than it received severe criticism and eminent men condemned it as impracticable. Fortunately for Buffalo the results have amply proven the incorrectness of such criticism. The faith of the investors was not shaken and the preparation of working plans was immediately begun. In order that such plans might be as perfect as possible an International Niagara Falls Commission was formed June 1890 composed of five noted engineers from America, England, France and Switzerland. Competitive design for power development were invited, prizes amounting to 22,000 dollars were offered and by January first 1891 22 designs were received from engineers dwelling from Buda Pesth to San Francisco. From these designs that of Faesch & Piccard of Geneva, Switzerland, was considered worthy of first prize and they proceeded with the design of the turbine wheels. It was decided that such wheels were to work under a head of 136 feet and after several modifications it was determined to place the wheels in one long slot in the rock, the end of such slot to be connected with the tunnel.

The form of wheels and their general arrangement having been decided upon, the next question that arose was the form in which their power should be employed and the method of its transmission. This may seem a very easy question to-day but look backward and put yourselves in the position of the engineers of 13 years ago. There were then only 3 examples of commercial electrical power transmission in the world, all of them in France, where power was transmitted for a short distance. Mr. George Westing-

house stated as his opinion that power could be transmitted from Niagara Falls to Buffalo by compressed air only. (Fortunately for Mr. Westinghouse's business he was mistaken) In spite of the meagre knowledge of electrical generation and transmission, it was decided in December, 1891, to ask for competitive plans and estimates for the generation of electrical power and its transmission, both locally and to Buffalo. After a thorough study of these plans the general form of dynamo was decided upon and a contract was let for the construction of three 5000 H. P. two phase alternating current 2200 volt machines at 25 cycles per second. You say you do not see anything very remarkable about that, that nearly every little water power plant in the country produces alternating current. Yes, it seems very easy after it has been done and proven successful, but it should be remembered that in 1891 nearly every great scientist in the world advised against the use of alternating currents and great credit should be given to the far-seeing wisdom of those who decided that the greatest plant in the land should use this form of energy. As a further example of the courage required to make the decision to generate electric power it may be remarked that in 1890 there was in use in the United States only 15,569 E. H. P., nearly all direct current. So the Niagara Falls Power Co. proposed to double by their first installation of three 5000 E. H. P. wheels the amount of electrical power employed in the whole country. The size of the units employed is also worthy of notice for while they have since been exceeded they were a great step in advance at a time when no dynamo of more than 2500 H. P. had been put in successful operation.

The general form and size of the wheels and the method of generation having been decided upon the next step was to plan the general arrangement of the station. It was decided to build a canal whose outer end should project about 600 feet beyond the then shore line, the lands under water to the outer end of the canal being filled with the excavated material. After many studies the mouth of the canal was located about 1400 feet above the mouth of the Hydraulic Company's canal. This head race had a width of about 180 feet at the mouth, 100 feet at the upper end, was 1500 feet long and 12 feet deep. When 100,000 H. P. is being developed from water supplied from this canal the maximum velocity in it will be about 4 feet per second. It is interesting to note that the canal was so planned that if electrical transmission had not proven a success, it could be extended for a mile and a half up the river so that the tunnel could be extended beneath it and hydraulic

installations could thus draw water from the canal and discharge into the tunnel. This was a wise provision but fortunately it has not been necessary to take advantage of it and no tenant of the Power Co. develops its own hydraulic power except the International Paper Co. whose plant was built before electric power was installed.

Before the commencement of their operations the Niagara Falls Power Co. and Cataract Construction Co. had purchased tracts of land on which their future tenants could locate, such holdings embracing 1581 acres or 2½ square miles, most of which is now within the city limits of Niagara Falls. A part of these holdings were taken over by the Niagara Development Co. for a model town and by the Niagara Junction Railway Co. for a terminal railway to transport raw material and finished products to and from the several factories, connections being planned with all trunk railroads entering the city. The Power Company's property has a river frontage of about two miles and the acquisition of lands under water gives dockage facilities for this entire length. A railway dock was built in 1893 and material can thus be transported by water and the Niagara Junction Railway to the doors of any tenant. Ample land and transportation facilities were thus provided by the company for all factories using their power.

The construction of the tunnel itself was a matter of no small moment even in these days of large numbers, involving as it did the removal of 300,000 tons of excavated material, the use of 16,000,000 bricks and an expenditure of over one million dollars. Ground was broken for shaft excavation in September 1890 and the contract for the construction of the first 6700 feet was completed in January 1893. Work was prosecuted from the portal shaft and from two intermediate shafts. The roof of the excavation is secured with timbers for most of its length and it is lined with 16½″ of brick work, the height and width inside of brick work being 21 feet and 18 feet 10 inches respectively. The slope of the tunnel is 7 feet in 1000 for 5000 feet and 4 feet in 1000 the remaining distance to the wheelpit. An interesting feature of the tunnel is the steel-lined ogee at the portal, a drop of 10½ feet occuring in a distance of 95 feet. This provision renders the tunnel accessible for inspection to the top of the ogee at all ordinary stages of the lower river. It may be remarked in this connection that on June 1st last all power was shut off from the plant and a thorough inspection was made of the tunnel. The masonry was found to be in perfect condition after seven years of service.

The wheelpit for the first installation was a slot excavated in the solid rock to a depth of 178 feet, the width being 18 feet and length 140 feet. This was completed in 1893 and in 1896 work was commenced on the extension of the pit to a length of 425 feet. The original wheelpit was excavated in the ordinary manner but in the extension the sides were cut from top to bottom with channeling machines, thus preventing the shattering of the rock beyond the desired limits. When the excavation of the extension was nearly complete grave apprehension was caused by a slight inward movement of the wheelpit and fears were expressed that such movement might continue and so ruin the installation made at so great an expense. It is a satisfaction to record that a very careful series of measurements covering a period of nearly six years show that such inward movement has now entirely ceased and it may be confidently stated that it will never occur again, being probably caused in the first instance by the blasting operations in the wheelpit extension.

As before mentioned, the first installation of the Niagara Falls Power Co. consisted of three units and a description of one of these will suffice for all of the machinery in the first wheelpit as the ten units now installed there are practically alike. Water passes to each unit from the canal through a masonry inlet 14 feet wide to the mouth of the steel tube, or penstock, 7′ 6″ diameter, through which it passes down the wheelpit to the wheel case, 141½ feet below the Power House floor. This wheel case is a huge casting about 10 feet in height and 6 feet in diameter and is filled with water under a pressure of 59 lbs. per square inch. The only escape for this water is through openings in the circumference near the top and bottom. The form of these openings is such that water passing through them comes in contact with the wheels placed immediately outside of them at exactly the proper angle to produce the required power. There are thus two wheels attached to each shaft, the water acting on them to produce 5000 H. P. From the above description you will note that the wheels are of the Fourneyron or outward discharge type. The water discharged from the wheels drops into the bottom of the wheelpit and thence goes into the tunnel.

The shaft to which the wheels are attached rises 155 feet to the top of the generator where it connects with the revolving field ring. Suitable bearings are of course provided to preserve the alignment of this shaft.

A very interesting feature is the manner in which the enormous weight of the revolving parts is supported. Consider for a moment a weight of 76 tons revolving at the rate of 250 revolutions per minute. The weight is equal to that of 1000 persons of average size and is moving at an average rate about equal to that of the Empire State Express. You can readily see that it is no slight task to support such a mass. Lignum-vitae, cast iron and steel have been successively recommended for this purpose but in wheelpit No. 1 the great majority of the revolving weight is borne by the same water that drives the wheels. It is difficult to explain this without the aid of a model, but some idea of the principle may be gained when it is said that a hole is cut in the top of the wheel case and into this hole is fitted a disc which connects the wheel to the shaft. This disc is so proportioned that the water in the wheel case acting upward with a pressure of 56 pounds per square inch of disc balances the moving weight.

As the pressure in the wheel case varies with the amount of power developed the revolving weight cannot be exactly balanced at all times, but with the Fourneyrou wheels such unbalanced weight under ordinary circumstances never exceeds 3500 lbs., and this is readily supported by collars placed on the shaft about 15 feet below the power house floor.

For electrical generation it is of course necessary that the speed of the turbines should be kept constant at all times. In order to accomplish this a cylindrical gate is placed on the outside of the wheels, such gate being connected by a series of levers with a governor placed on the power house floor. The gate is thus raised or lowered to correspond to the amount of load on the generator. For example if the machine is fully loaded the gate is raised to its highest position, thus uncovering the entire wheel and allowing the maximum amount of water to escape. If then a customer connected with such dynamo should suddenly throw off 2500 H. P. it would be necessary that the gate should be approximately half closed or one half of the power developed would be used to make the wheel run away. Immediately upon the withdrawal of the half load the governor automatically acts to half close the gate. More than once during the operation of the plant the entire load has been instantly thrown off and the governors have closed the gates without any serious increase in speed. The strength of the revolving parts is so calculated that the speed may be increased 60% without increasing the stress beyond the safe limit. The governors on the first three units were designed by Faesch & Pic-

card and are purely mechanical in their action. The governors on units 4 to 10 inclusive are electro-mechanical in their action, while those for units 11 to 21 were designed by Escher, Wyes & Co. of Zurich and are operated by oil under high pressure.

To revert to the history of the plant,—the power furnished was so satisfactory and the demand for such power increased so rapidly that on January 22nd 1897 a contract was let for five additional units of 5000 H. P. and on January 25th, 1899 a further contract was made for two additional units, making a total of 50000 H. P. As this amount of power still proved insufficient to serve the purpose of local tenants and of the Buffalo load a still further installation became necessary and the important question arose as to where such additional power should be developed. As the tunnel was originally built with a capacity of 100,000 H. P. the water from the future wheels to the extent of 50,000 H. P. would of course be discharged into the tunnel, but the question was whether additional wheels should be placed in an extension of the first wheelpit or in a new wheelpit placed on the opposite side of the canal. After careful consideration, the latter plan was adopted and on November 3rd, 1899, a contract was let to excavate a new wheelpit 468 feet long, 20 feet wide and about 178 feet deep, an extension of the tunnel, 650 feet long, being made to connect such wheelpit with the old tunnel. The plan adopted has many advantages, among them being the opportunity to build a power house which should embody the results of the experience gained in operating the first power house, the distribution of current between the two sides of the canal, and the added secufity against interruption of service. In other words, the eggs would not all be in one basket. You know Mark Twain says to "place all your eggs in one basket and then watch that basket" but in spite of continual watchfulness eggs are sometimes broken. This second wheelpit has now been completed and six 5500 H. P. turbines with their shafting and generators are now installed in it. Five additional units are ordered and their installation has now commenced. By next fall such units will be completed and the Niagara Falls Power Co. will thus have a total of 110,000 electrical H. P. for sale.

The turbines placed in wheelpit No. 2 are of an entirely different type from those in power house No. 1. Only one wheel instead of two is attached to each shaft and the water from the wheel case passes in an inward and downward direction through this wheel, being discharged, not into the air, but through two draft tubes into the water in the bottom of the wheelpit. These wheels were designed by Escher, Wyss & Co. of Zurich, Switzerland.

A very interesting and important test was made on November 19th, 1901 to conclusively determine the carrying capacity of the tunnel and thus prove the correctness of the calculations made in designing such an unprecedented engineering structure. An amount of water was discharged through the wheels, completed and uncompleted, in wheelpits 1 and 2 equal to that which will be required for wheels generating 105,000 H. P. in commercial service and it was found that the tunnel readily discharged this quantity of water.

Time forbids more than a brief reference to that most interesting problem, the manner in which electric power is transmitted to Buffalo. The current from the generators flows to the switchboard where the controlling devices are situated and thence to the largest transformers ever manufactured where the voltage or intensity, of current is raised from 2200 volts to 22,000 volts. It then passes over bare copper wires through the intermediate towns to the terminal house in this city where the voltage is reduced to 2200 volts for local distribution to the various sub-stations. Three separate and distinct transmission lines of three wires are now in use and if any of these lines is interrupted the current can be transmitted on the other two lines. These lines are daily patrolled and constant watchfulness is exercised to prevent such interruption.

But while power development on the American side has thus been advancing by leaps and bounds, the Canadian shores have not escaped the attention of capitalists anxious to utilize a part of Niagara's energy. The material features of the problem there presented are quite similar to those already described, but the business aspects of the case are somewhat different. The Province of Ontario has set aside for park purposes a large tract lying between the upper Suspension Bridge and the Dufferin Islands and in addition control a strip of land 66 feet wide extending from Lake Erie to Lake Ontario. As the works of any water power plant must necessarily cross under or over, or be situated upon such park lands it is evident that all Canadian water power development must be subject to the control of the Park Commissioners and in turn to the Ontario Legislature. It was evident, however, that a power house located in the Queen Victoria Niagara Falls Park whether on the upper or lower river would be much nearer the falls than would be possible on the American side as the State of New York would permit no power development within the boundaries of its property. Being desirous of securing an opportunity for so favorable a development, a number of American and

Canadian capitalists organized the Canadian Niagara Power Co., with the late Albert H. Shaw as President, and on April 7th, 1892 entered into an agreement with the Park Commissioners whereby upon the payment of certain rentals such company was authorized to develop one hundred twenty-five thousand horse power within the park lands in their first power house. This agreement was confirmed by the Ontario Legislature April 8th, 1892 and a charter issued to the company. But in 1892 electrical generation on a large scale was comparatively new and long distance transmission was in its infancy. As a number of the same men were interested in both The Niagara Falls Power Co. and the Canadian Niagara Power Co. they desired to obtain the benefit of the experience to be gained from the American plant before building the costly structure required for their development. Accordingly a new agreement was made with the Park Commissioners July 15th, 1899, and an extension of time secured for the beginning of power development. The plan for utilizing the power is similar in general principles to that of The Niagara Falls Power Co. The power house will be situated at the foot of the slope forming the former river bank and just below the old Carmalite Monastery and south of the Falls View Station. To the power house thus beautifully situated water will be conducted from the rapids by a symmetrically shaped canal spanned by a stone bridge of 5—50 foot arches. The discharge water from the turbines will be conducted to the lower river by a tunnel having the same horse-shoe form as the American tunnel, but four feet greater depth. The most interesting feature of the plant is the size of the units. The original plans contemplated the use of 5000 H. P. machines, but it was found that both the turbine designers and the electrical manufacturers were willing to undertake the building of units of double that size, although nothing of the kind had ever been done successfully. The advantages of the plan are evident as a reduction of nearly 50% is made in the length of the wheelpit, canal, and power house per given amount of power development. The result of the designers skill will be machines of monstrous size. Imagine if you can, a single machine capable of generating 1⅓ times the entire amount of electricity employed for all purposes at the late lamented Pan-American Exposition. A penstock 10′ 2″ diameter conducts the water to a wheel case 13 feet diameter and 14 feet high, discharging water through two Jonval type turbine wheels with draft tubes, the total head being 136 feet. This monster when fully loaded will use four times the quantity of water in a given

length of time that is supplied to the entire city of Buffalo from all its enormous pumps. The generator is of the inward revolving field type, revolving 250 revolutions per minute with a peripheral speed of 110 miles per hour, generating current at 12000 volts. The entire weight of the revolving parts of the macnine is 251,000 lbs., or about the weight of the bricks in a good-sized dwelling. Such weight will be sustained as in the American turbines by water and oil under heavy pressure. A large amount of work has now been done toward the development above described. The tunnel excavation is practically finished, the wheelpit excavation is nearly completed, the canal is practically dug and a considerable amount of masonry is in place. A contract has been made for five 10,000 H. P. dynamos which are to be built in this country, while three 10,000 H. P. turbines are being manufactured in Zurich, Switzerland, and contract for two more will soon be let. The first installation will thus be 50,000 H. P. but the canal, wheelpit and tunnel are all built for the development of 100,000 H. P. in addition to a reserve unit.

The next company to engage in power development on the Canadian side was the Ontario Power Co. in which Buffalo capital is so largely interested. This company entered into an agreement with the Park Commissioners April 11th, 1900, by which they were given rights for two forms of development. The first method was to bring water through an open canal from the Welland River near its junction with the Niagara River to the top of the high bluff west of the park, where a fall of about 50 feet was available upon wheels in a power house located within the Park at the foot of the bluff. The discharge water was to be at first conducted to the upper river but at a later time to flow in a canal to the high bank of the lower river near the Table Rock House, where it would enter penstocks and there be led to wheels in a power house situated in the gorge on the bank of the lower river. The powers of the Ontario Power Co. have since been increased and its plans have been somewhat changed. A large temporary coffer dam of timber and puddle has been constructed in the upper river near the Dufferin Islands, thus cutting off the flow of water around these islands for the first time in history. While this coffer dam is in place a permanent stone wing dam will be constructed with its top below the surface of the water. The bottom of the river will be dredged and there will be built an entrance forebay with regulating devices from which an underground pipe 18 feet in diameter will be laid to a point just north of the Table Rock House. Pro-

vision will be made for three pipes, one of which will supply the first installation. Upon the completion of the head works it is the intention of the Co. to remove the coffer dam and to restore the natural features at the Dufferin Islands to practically their original condition. None of the works of the Ontario Co. will appear above the surface of the ground in the Park proper. The total contemplated installation with water from the upper Niagara is 150,000 H. P. of which 50,000 H. P. will comprise the first installation. One 18 foot penstock will supply water for each installation of 50,000 H. P. Such penstocks will enter a huge brick shaft built below the ground. From this a separate penstock will lead to each of the 10,000 H. P. turbines located in a power house built of native stone in the lower gorge. This power house is planned to have an ultimate length of 1050 feet and a width of 90 feet. The head on the wheels will be 174 feet. Plans still continue for the utilization of power from water to be brought from the Welland River, but these plans will probably not be carried out until the first project is completed. Considerable work has already been done in blasting away the rock for the power house and preparations are completed for active work at the entrance.

A third company has recently entered the field of power development on the Canadian side. This Company, composed of Toronto capitalists and known as the Toronto and Niagara Falls Power Co., have obtained rights for the development of 125,000 H. P. Their plans are not yet worked out in detail but they include in general a power house on the upper river shore supplied with water from a forebay created by building a wing dam into the upper rapids. The wheels will be situated in a wheelpit and water will be discharged by a tunnel at a point beneath the horse shoe falls.

Power development at Niagara Falls, present and proposed, may be summarized as follows:

The Hydraulic Power and Manufacturing Co. have 38,000 H. P. developed, are commencing a power house for 50,000 H. P. additional and can make a total development of 125,000 H. P. The Niagara Falls Power Company have 80,000 H. P. ready for service, are installing 25,000 H. P. additional, which will be completed next fall, and have rights for an additional 125,000 H. P. The Ontario Power Company contemplate using 300,000 H. P. and are at work on the installation of 50,000 H. P. The Toronto and Niagara Falls Power Co. have obtained rights for developing 125,000 H. P. and are commencing the installation of 50,000 H. P. The following are the totals; now developed, 118,000 H. P.; in process of development, 225,000 H. P.; rights secured for 1,150,000 H. P. Please remember that the total water power developed in the United States in 1900 was less than 2,000,000 H. P.

Such is the history of water power utilization at Niagara in the past and its condition at present. But what of the future and of the influence of that future on the prosperity of Buffalo? And by Buffalo we mean the greater Buffalo. Must we leave to our real estate friends all the roseate views of Buffalo future greatness? I

think not; I believe that as scientific men and women we may look forward with all confidence to a marvelous growth in our city. That water power generating electricity is to be the power of the 20th century needs but little argument. Wood as a source of heat and power need not be considered and it needs no prophet to foresee the time when the coal mines of the U. S. will be exhausted. Long before that time the price of coal will be so high as to prohibit its use for the generation of large blocks of power. You are all aware of the marked increase in the normal, (not strike), prices of soft coal in the last ten years. The exhaustion of the natural gas fields is so rapid that gas is not a factor in the problem. Look which way we may the inevitable conclusion is that recourse by the great factories must be had to the water powers of the country. Of all the hydraulic developments that the 20th century will witness, which is best situated, which is on the grandest scale, which is most unfailing? Without question that at Niagara Falls. With a reservoir capacity in the Great Lakes of 90,000 square miles, (twice the area of the Empire State), uneffected by the droughts of summer or the freshets of winter, Niagara will stand through the centuries as the emblem of mighty, unfailing, never ceasing power. With this mighty giant delivering the fruits of his labors at her very doors, with unsurpassed railroad facilities, with the iron of Messaba, the copper of Michigan, the grain of Dakota transported by water to her wharves, what city in the world can offer to manufacturing interests such inducements to locate within her boundaries? Buffalo's future greatness rests on no vain product of the imagination but on solid, scientific facts which cannot be belittled or gainsaid, and only the fleeting passage of time brief as the days of a man is needed to make Buffalo the great manufacturing center of the land. The crowning success of her municipal life may not be reached until you and I have ceased the more strenuous labors of life and sit with folded hands in the chimney corner of old age, when the whir of the mighty wheels of her factories falls on our dulled ears, when the vista of Niagara's far reaching activities is seen through our dimmed eyes, but come when it will we will go to the source of all power more content because we have done our little part in developing one of the wonders of the 20th century and adding untold wealth and happiness to the city of our choice. The fable of the rainbow has come true and the shimmering bow that ever spans Niagara's gorge holds at either end the hoarded wealth of the ages which will be poured into the lap of the Queen City of the nation.

(The End.)

Vol. VIII. No. 2.

BULLETIN

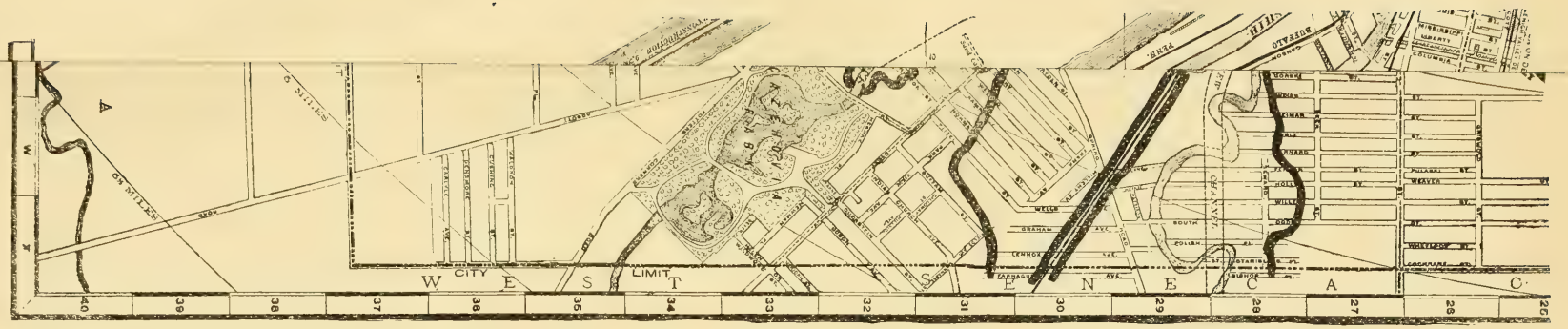
OF THE

BUFFALO

Society of Natural Sciences

"South Buffalo Floods and Proposed Remedy."

BUFFALO, N. Y.
Press of REINECKE & ZESCH, 352 Ellicott St.
1903.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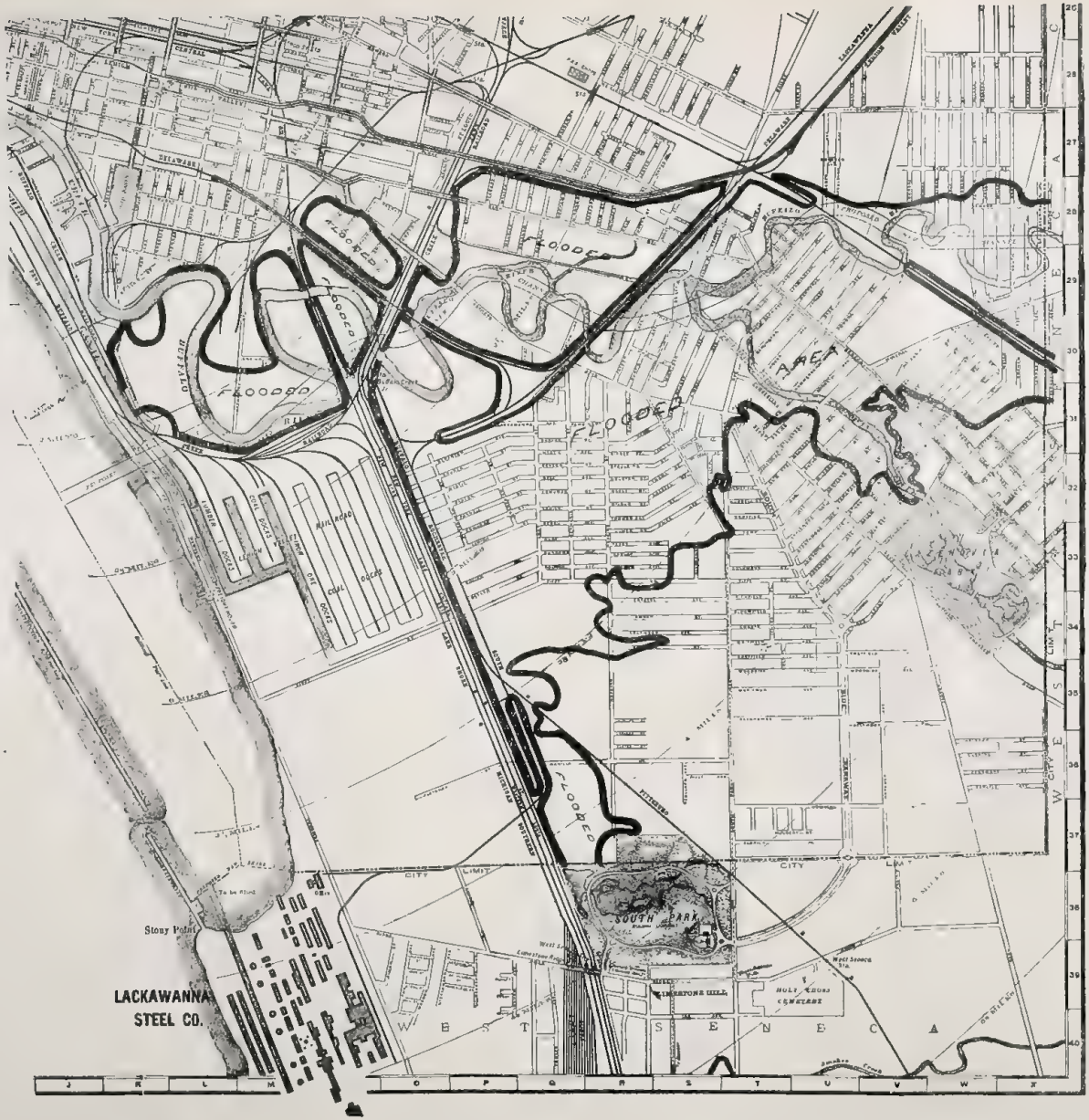
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BULLETIN
OF THE
BUFFALO SOCIETY OF NATURAL SCIENCES.

Vol. VIII. No. 2.

South Buffalo Floods and Proposed Remedy.

CHARLES M. MORSE,

Deputy Engineer Commissioner Dept. of Public Works, Buffalo.

It seems to me almost necessary that I present to you some excuse for addressing you on this subject, in view of the fact, that the subject has been very much abused by having been discussed in the daily papers, and otherwise, in such fashion that anything short of an abstract scientific presentation of it here would seem only further aggravation, and I am not prepared to give you anything more than a very general description of the problems involved, and as an excuse for touching on the subject at all, I shall treat it principally on commercial grounds in the general interest of the City of Buffalo.

The hydraulic problems involved have been very carefully studied and all the data and conclusions are in the possession of the Department of Public Works of the city.

The good people of Buffalo have been favored by the newspapers with all sorts of criticisms, wild statements, and attempts to explain natural phenomena in rather unnatural ways, principally in the shape of contributions from regular subscribers, taxpayers, alleged public benefactors, etc., but I have not noticed very much in the way of honest efforts on the part of the newspapers to inform the public of the actual situation, which might be done by a little careful collecting of available facts and figures. On that account, I think it may be well for me to present what I know of the situation in such shape that it may reach some of the thinking public, and probably this is the best place to find that part of the public.

FEB 8

Up to a quite recent date, apparently what data had been secured, that might be of use in discussing a remedy for the troubles experienced, had not been put into tangible shape for use, but now the problems at issue are practically solved and the subject is very clearly understood.

To state the subject, I would say the Buffalo River flows within the city limits through an alluvial valley which at times is overflowed by the waters of the stream because they are in excess of the carrying capacity of the channel, or are forced out of the channel by temporary obstructions.

The area within the city that is flooded is a varying amount, reaching a maximum of about 1600 acres. No two floods cover exactly the same bounds.

The population of the area flooded is about 10,500 and the assessed valuation of the lands is about $5,000,000. The value of this section of the City of Buffalo seems to be defined by the flood conditions.

The location of this area would naturally tend to make it a very valuable part of the city except for this one serious drawback.

Considering it simply as a residence section and making a rough calculation of the cost of the floods on very conservative lines; let us assume that a flood costs the average resident at least one day's wages, or $3 00—(he is generally detained from his work by the flood:) the damage to provisions and premises $1.50, and the cost of cleaning up $1.50, or a total of $6.00. $6.00 is the annual value of $100 00. The actual immediate value of the area flooded—1600 acres, would therefore be increased by abatement of the flood $100 per average building lot, or $1000 per acre, a total of $1,600,000. 1000 acres of land lying beyond the flooded area has its access to the city cut off by each flood, or at least one day per year, which costs at least $3.00 per building lot—the annual value at 6% of $50, or $500 per acre, or for the 1000 acres a total of $500,000. This gives a total of $2,100,000 as a conservative estimate of the increased valuation that would result by abating the floods; that is, one flood per year, and there are more.

The increased valuation of property for manufacturing industries, which are now practically barred by the existing conditions, might be estimated in the same way at a very large amount, but the above figures will easily indicate to any business man that an expense of $2,100,000 would be a very reason-

MAP
OF PART OF
ERIE AND WYOMING COUNTIES
SHOWING THE WATERSHED
OF
BUFFALO RIVER & CAZENOVIA CREEK
SCALE 1 IN = 2½ MILES


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OF PART OF
ERIE AND WYOMING COUNTIES
SHOWING THE WATERSHED
OF
BUFFALO RIVER & CAZENOVIA CREEK
SCALE 1 IN = 2½ MILES
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LAKE ERIE
CHEEKTOWAGA
LANCASTER
LDEN
WEST SENECA
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MARILLA
BENNINGTON
ATTICA
EAST HAMBURG
AURORA
WALES
SHELDON
ORANGEVILLE
HAMBURG
EVANS
EDEN
BOSTON
COLDEN
HOLLAND
WYOMING COUNTY
WETHERSFIELD
BRANT
NORTH COLLINS
COLLINS
CONCORD
SARDINIA
ARCADE
EAGLE
CHAUTAUQUA CO
ERIE CATTARAUGUS COUNTY
CATTARAUGUS CREEK
ERIE CATTARAUGUS COUNTY
CATTARAUGUS CREEK

(Cut 1.

able proposition and would be a profitable investment by the city.

About two miles inside of the city line and six and three-quarter miles above the outlet of the Buffalo River it is joined by Cazenovia Creek. These two streams, with their tributaries, drain a watershed of approximately 413 sq. miles.

The map shown, herewith, gives a fair idea of the country drained. (Cut 1.)

The distance from the headwaters of Buffalo River to its outlet in Lake Erie is approximately 50 miles. About 6¾ miles above its outlet, it is joined by the Cazenovia Creek, whose total length is about 26 miles; about 10 miles from the outlet of the Buffalo River it is joined by Cayuga Creek, whose length is about 39 miles.

The watersheds of these different streams are approximately as follows:

Buffalo River proper,	145 sq. miles
Cayuga Creek,	127 sq. miles
Cazenovia Creek,	87 sq. miles
Branch Cazenovia Creek,	54 sq. miles

making a total of 413 sq. miles of territory which contributes to the waters of the Buffalo River below its junction with Cazenovia Creek.

From the report submitted by Mr, Rudolph Herring to the Board of Public Works, under date of July 24th, 1899, I have taken the following statement of flood conditions:

	Watershed Sq. Miles	Total Max. flow cu. ft. per sec.	Rate in cu. ft. per sec. per sq. mile
Buffalo River above Junction with Cazenovia Creek,	272	17000	62.5
Cazenovia Creek,	141	8000	56.7
Buffalo River below junction,	413	23000	55.7

From later measurements I learn that the total flow is under stated, for maximum flood conditions.

A comparison with other streams subject to similar freshet conditions is interesting and I am able to quote the following figures from observations on such streams:—

	Watershed Sq. Miles.	Total Max. flow cu. ft. per sec.	Rate in cu. ft. per sec. per sq. mile.
Perkiomen River, Pa.,	152	10518	69.2
Croton, N. Y.,	339	25300	74.9
Ramapo, N. J.,	160	10540	66.1
Falls Creek, N. Y ,	117	4800	41

Apparently the statement of flood flow for the Buffalo River below the junction with Cazenovia Creek is less than for the Croton River with a somewhat smaller watershed. This is not inconsistent in the light of known conditions. Heavy rain storms are greater and produce greater floods on the Atlantic slope of the Alleghany Mountains than on the western slope. The same may be noted of the Perkiomen and Ramapo floods.

The flood of February 9th, 1900, reached a very high stage in the lower portion of the Buffalo River, due to a westerly gale, together with an ice and boat jam. The estimated discharge of this flood was but 18000 cu. ft. per second, and the high water in the lower river was evidently due to the peculiar conditions noted.

On February 28th and March 1st, 1902, there appeared a flood which produced the largest measured discharge, and reached the highest recorded general level of overflow on the upper parts of the streams within the city limits. The actual measurements of flow in the channel gave a total of 24300 cu. ft. per second.

It is the custom to establish observers at several different points when floods are expected and generally it is easy to predict a flood from 5 to 20 hours before it arrives at the city line. This last flood came a little sooner than was expected, and some of the observers were not aware of the conditions until the morning of March 1st: however, two fairly continuous sets of gauge readings—one at the head of navigation and the other near the center of the flooded area, at the junction of the Buffalo River and Cazenovia Creek, were obtained, which, with the records of the United States Engineer's recording gauge near the mouth of the river, give a very fair idea of what occurred.

The slope of this flood and others is shown upon the accompanying diagram of flood heights.

These records of gauge readings, together with float tests made at different points on the stream, where fairly accurate measurements of channel capacity can be made, enabled us to estimate the amount of flow of water under different flood conditions.

Measurements of the channel before and after floods have enabled us to determine, with some degree of accuracy, the effects of the floods in the matter of deposit in the river bottom

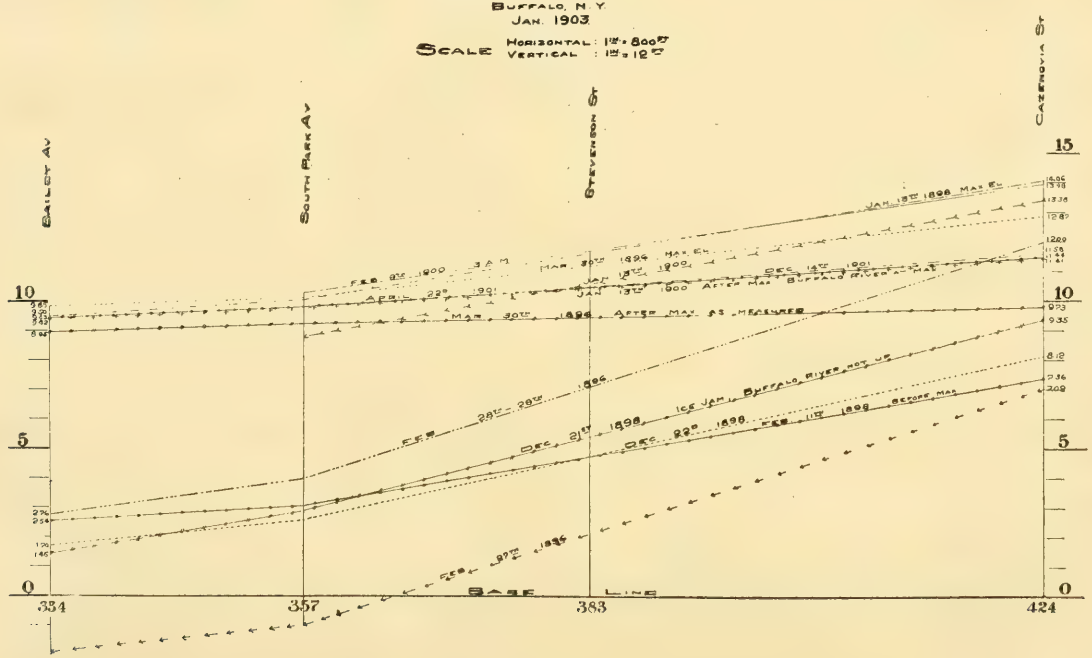
FLOOD HEIGHTS
CAZENOVIA CREEK.

FROM 1896 TO 1902 INCLUSIVE

HEIGHTS SHOWN AT VARIOUS POINTS ARE MAXIMUM EXCEPT AS NOTED

BUREAU OF ENGINEERING
BUFFALO, N. Y.
JAN. 1903.

SCALE HORIZONTAL: 1" = 800'
VERTICAL: 1" = 12'



of silt, and also to determine the scouring and eroding effect of the current.

The accompanying profile of the bottom of the river, together with the flood profiles showing the slope of the surface of the water, give a graphic illustration of the action of the several floods of which we have records. (Cut 2.)

Referring to the map of the city:—the valley of the Buffalo River once entered Lake Erie south of the Tifft Farm, but probably the action of the shore currents of the lake forced the outlet of the river further north until the stream was forced upon a rocky ledge at Louisiana Street and near the outlet. This acted as a barrier and caused floods upon the lower portion of the stream.

Within the past thirty-five years some half a million dollars have been expended between the Erie Railroad freight house and Hamburg Street for deepening and improving the channel through the rock, and this work has prevented the recurrence of floods which formerly occured in that locality, by providing an adequate channel for the passage of the water. This fact will be referred to later as bearing upon the proposed method of abating the floods.

The present conditions inside the city limits, and in the section of the city known as "South Buffalo", are as follows:—

At irregular intervals—at least twice or three times each year, the banks of the Buffalo River and of the Cazenovia Creek inside of the city (we will not consider the conditions outside of the city line) are overflowed by the sudden melting of snows, or by heavy rains on the upper reaches of the streams, and an area of about 1600 acres is for a short time under water. The floods do not always reach the same defined limits of area, but about that amount of territory is subject to disastrous flooding.

The usual programme is about as follows :

A heavy continued rain when the ground is frozen, or previously saturated, as for example, the flood of May 20th, 1894, and that of July, 1902. More often the flood conditions are produced from melting snow, or a combination of such with rain, or even thunder storms, as that of Jan. 29th and 30th, 1903.

The summit of the flood wave usually follows the crest of the storm, or greatest run-off in melting snows, by about 12 hours, the maximum flow in Cazenovia Creek occurring from three to six hours before that in the Buffalo River. The usual statement in the news items to the effect that the flood was en-

FLOOD HEIG

OF BUFFALO

FROM 1890 TO 1902 INC

EIGHTS SHOWN AT VARIOUS POINTS ARE

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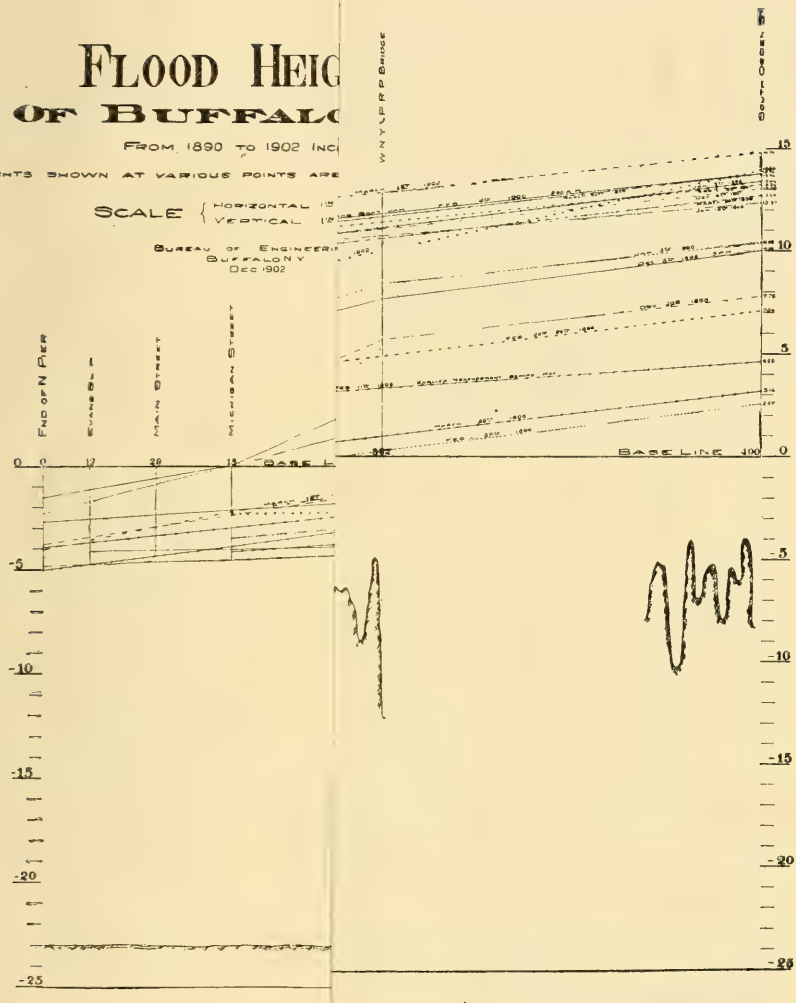
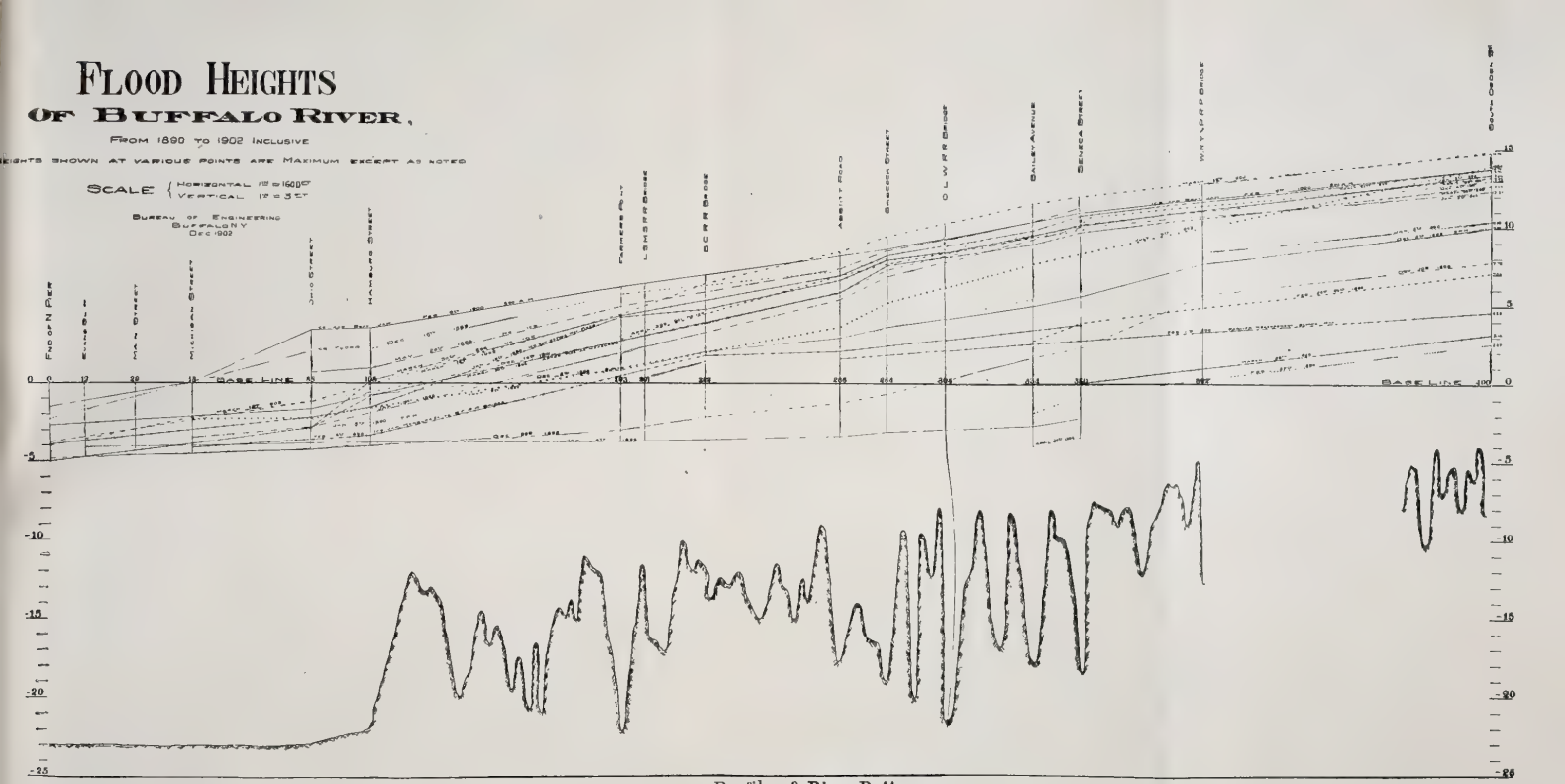




Profile of River Bottom.

(Cut 2.)

tirely unexpected is as accurate as the statement that "this is the worst flood ever experienced in South Buffalo." We have them every year at about the same times.

I am able to show here a few illustrations of the effects of these annual occurrences in South Buffalo.

During the ordinary stages of the Buffalo River it crosses the city line in a small channel and is apparently very insignificant. In the case of high floods, it crosses that line in a stream about 3000 ft. wide on the surface and sweeps over South Buffalo at a nearly constant width, interspersed, however, with high points, railroad embankments, bridge abutments, etc.

From observations and measurements made March 1st, 1902, it was determined that the channel of the lower Buffalo River was called upon to carry a flow of 25,000 cu. ft. per second. This flood was coincident with other unusual floods in this section. It was caused by the melting of a heavy body of snow which had been on the ground for some time. The run off began as soon as the waters began to cut their way through the hard snow. It seems probable that the conditions favored a flow of longer duration than usual and that Cazenovia Creek, while reaching its maximum three or four hours earlier than Buffalo River, held such maximum flow until the latter also reached its maximum. If this be true, then deductions made from former measurements and observations, that the respective maximum discharges were 8000 and 17,000 cu. ft. per second for the two streams seem to be verified.

Another element entering into the estimate of discharge from measurements on the lower section of the river in 1902, is the fact, that at that time about 1600 acres (the largest area of which we have record) was overflowed within the city. This represents storage at about the maximum discharge.

A rough measurement of the contour of the country overflowed, gives a total storage within the city of 161,172,000 cu. ft., equivalent to 1 hr. 47 min discharge of the stream at the above stated maximum of 25,000 cu. ft. per second, and this amount of storage in the time stated would indicate a maximum entry of water into the city of 29,800 cu. ft. per second, or an increase over measured amount of flow in the channel of 18%. Assuming these figures to be correct, which I believe they are nearly, this would indicate the largest flood of which we have record, no other flood of nearly as large measured discharge having occured in 8 years.

The minimum discharge of the Buffalo River below the junction with Cazenovia Creek is about 60 cu. ft. a second. The maximum discharge in full flood is about 25,000 cu. ft per second.

I think the foregoing statements can be taken as fairly representing the existing conditions and as indicating the necessity for some action to remedy the disastrous effects. The remedies that have been suggested are several and I will endeavor to explain the result of the studies of the subject. The subject has been intelligently studied with a view to the desired remedies by no one apparently except the city authorities with the application of a technical knowledge of the hydraulic problems involved.

The means of preventing the overflow may be classed as follows :

First: The storage of flood flow outside of the city so that the waters may be held back and discharged at no greater rate than will be cared for by the natural channel of the river.

Second: The diversion of the waters to some other outlet outside of the city.

Third: The raising of the entire territory affected above the flood level.

Fourth: Providing an adequate channel within the city.

The first suggestion—that of storage outside of the city is subject to the following conditions:—If storage is to regulate the flow to a certain maximum amount, the controlling works must provide for a free passage of all waters without storage up to the carrying capacity of the stream and hold back all in excess of that amount. This condition would demand an expensive and complicated construction. In the flood of March 1st, 1902, to have prevented the overflow of the city streets a storage capacity of at least 22,000 acre feet would have been necessary—that is, it would have required a reservoir covering 1000 acres, with a depth of 22 ft., to have stored the amount of water which overflowed the section of the city flooded. This would be a lake ½ mile wide, 3 miles long, and deep enough to float any lake craft. Such a proposition would require the acquisition of a large area of land and probably of very valuable agricultural lands, the reconstruction of road bridges, and possibly railroad beds. Such reservoir should at all times of low water be empty, that it may be in readiness for the floods when they come, and it would be a nuisance.

Furthermore, the locations of the several streams and the natural lay of the country would apparently require storage reservoirs on three different streams—Cazenovia Creek, Buffalo River and Cayuga Creek.

Considering the second proposition—the diversion to some other outlet outside of the city, there does not seem to be any safe place for such diversion, except that Cazenovia Creek might be diverted into Smokes Creek.

To illustrate the value of such diversion, it may be stated, that should the entire stream be diverted into Smokes Creek, it would not prevent the present troubles. The maximum freshet discharge of Cazenovia Creek is not over 8000 cu. ft., and in ordinary flood it would not exceed 5000. Possibly that 5000 cu. ft. of flow might be diverted into Smokes Creek and so made to overflow a small stream which already has a bad name as a flood maker along its own course and would seriously damage large interests now located at its outlet. The most recent flood of which we have record caused considerable damage at the outlet of Smokes Creek.

Furthermore, the records show that the maximum flow in Cazenovia Creek in case of a freshet occurs several hours previous to the maximum flow in Buffalo River, and usually the Cazenovia Creek flood has commenced to subside before the Buffalo River flood reaches its maximum. Such diversion would be expensive. Different estimates of the cost vary all the way from $250,000 to $600,000, and do not give any accurate information as to probable land damages. The suggestion does not seem worth considering.

The third suggestion—that of raising the level of the entire territory affected, would certainly remedy the trouble, but to raise the level of the improvements now housing over 10,000 people, as well as many miles of improved streets, would not prevent flooding of cellars unless carried to an extreme extent.

The sewage of South Buffalo discharges into Cazenovia Creek and Buffalo River and the discharge of the sewers is naturally affected by the height in water of those streams. Filling for the purpose of raising the level of this territory is not easily obtained in that section. The amount necessary to fill the space occupied by the overflow waters of 1902 would be about six million cubic yards. That suggestion does not seem worth considering.

The fourth plan mentioned—that of providing an adequate channel within the city seems to be the only feasible as well as efficient method of handling the proposition.

With this proposition in view extensive surveys and measurements were made and after much figuring and arguing, a sort of a compromise plan was adopted by the Board of Public Works and the work of widening and deepening the channels of Buffalo River and Cazenovia Creek on present lines was advertised in 1900 and bids received. The bids were reported to the Common Council and referred to a committee, where I believe they still are.

I refer to this as a compromise plan, because the engineers employed to criticise it, as well as the engineers who designed it, apparently agreed that quite radical changes of the channel in the shape of short cuts across country would be better, but that the present channel was the line of the least resistance in the matter of property damages. It was also considered to be less expensive than would be the building of a straighter channel, but that must have been due to the failure to obtain estimates from the engineers employed.

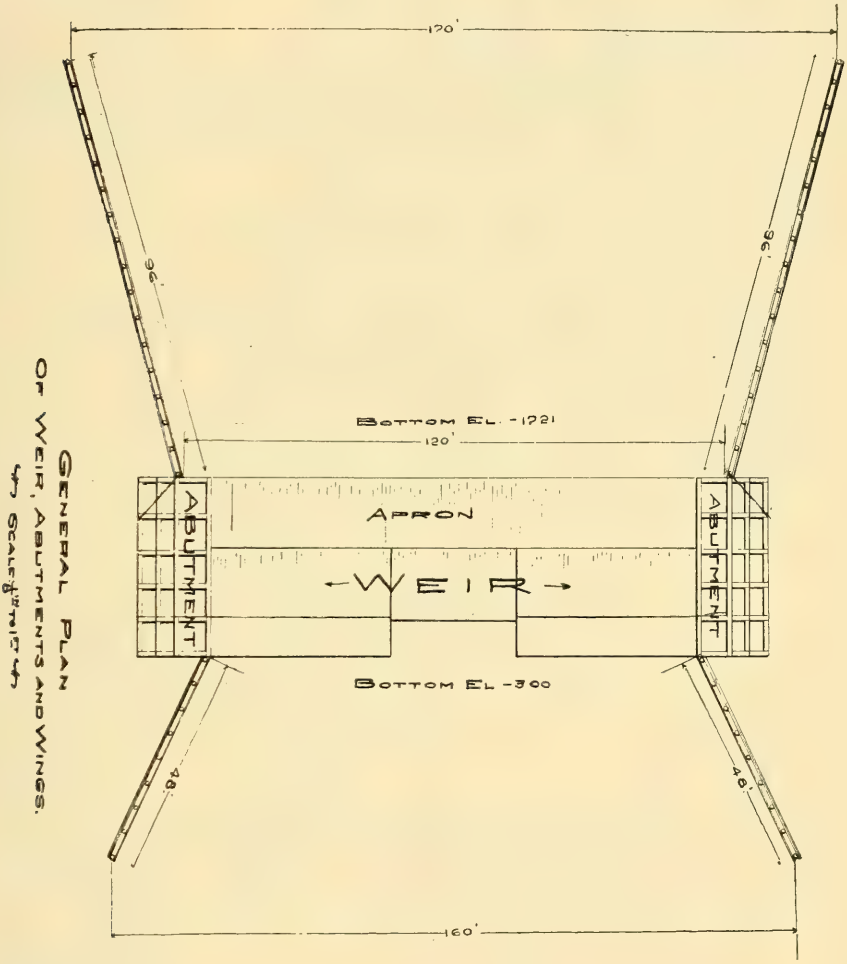
The asserted great cost of straightening the channel, due to the necessity of providing new railroad bridges is not a charge upon the people of the territory benefitted nor upon the city—The Buffalo River within the city limits is, according to the laws of the state of New York, a navigable stream and is recognized as such by the United States authorities—as such, it is subject to the Federal laws in the matter of crossings—Such crossings are an individual charge upon those enjoying the privilege.

The cost of necessary extension of sewers and construction of new outlets will be about $19,000.00.

In April, 1902, a preliminary plan for straightening, widening and deepening the channels within the city limits and a cut-off, or additional discharge into the lake, or what is now known as the outer harbor on account of the new breakwater construction, from a point about 10,800 feet from the present outlet of the river was approved by the Commissioner of Public Works and submitted to the Common Council. By order of the Common Council, a survey was made, and the work in accordance with this plan carefully laid out and estimated.

Bids were received for the excavation of this proposed new line on the 24th of February of this year. The work which it is proposed to do, I will endeavor to describe.

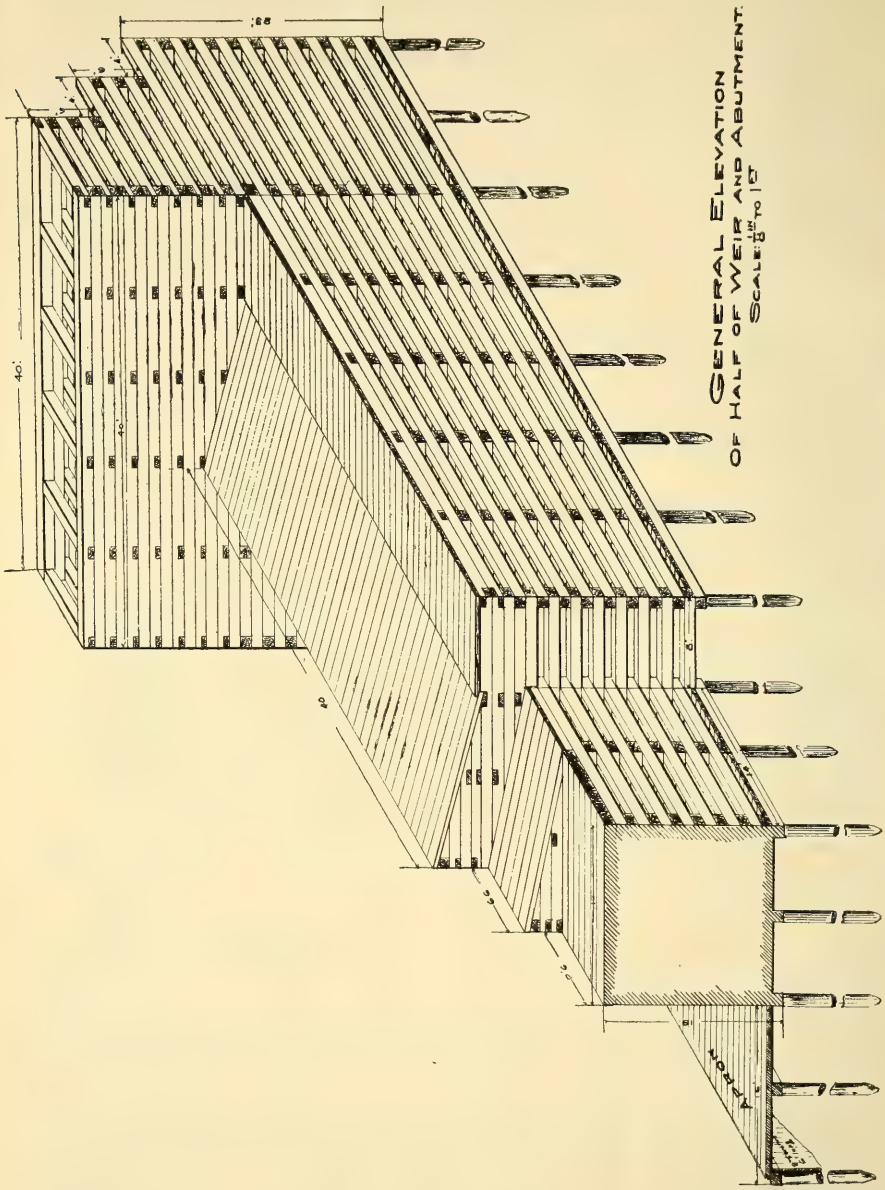
At the city line on the Buffalo River there will be constructed a controlling weir consisting of rock filled timber crib work



GENERAL PLAN OF WEIR, ABUTMENTS AND WINGS. Scale 1/16" = 1'-0"

founded on piles, together with wings above and below and an earth fill along the city line from such weir to the Mineral Springs Road.

I am able to show you drawings of the weir construction, which I think quite clearly explain it.


GENERAL ELEVATION
OF HALF OF WEIR AND ABUTMENT.
SCALE: 1/8 IN TO 1 FT
40'
40'
NORTH

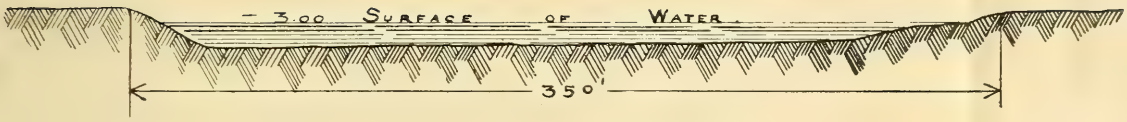
TYPICAL SECTIONS.

OLD CHANNEL

SCALE: 1 IN = 50 FT

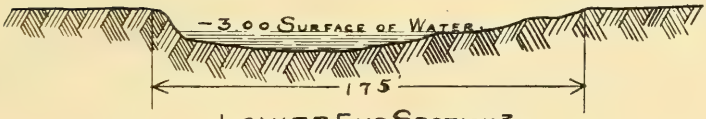
BUREAU OF ENGINEERING

BUFFALO N.Y.

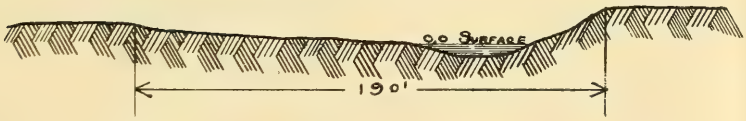


LOWER END SECTION 2.
HAMBURG ST.

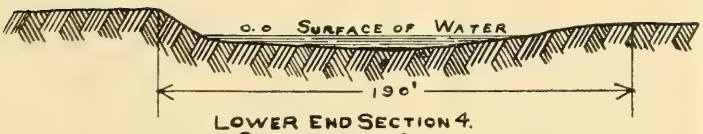
UPPER END SECTION 2.
BAILEY AV.



LOWER END SECTION 3.
SENECA ST.

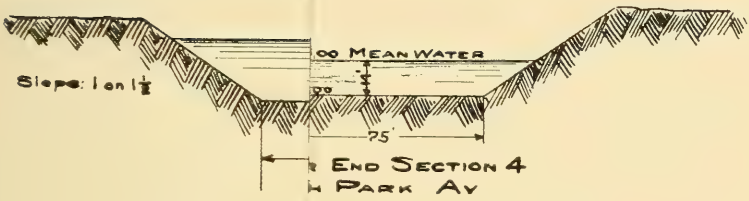


UPPER END SECTION 3.
CITY LINE.



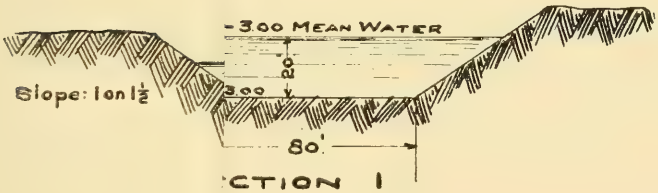
LOWER END SECTION 4.
SOUTH PARK AV.

(Cut 5.)

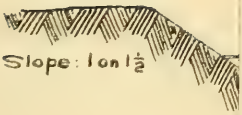


END SECTION 4
H PARK AV

END SECTION 4
ZENOVIA ST.



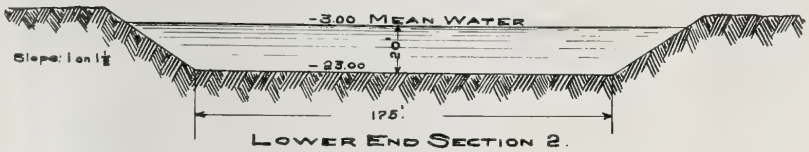
CTION 1
UTLET.



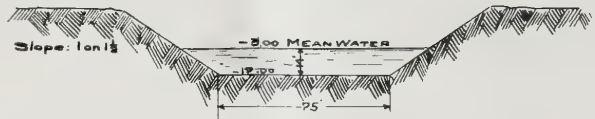
Typical Sections
New Channel
In Full Cut.

Scale: 1 in = 50 ft

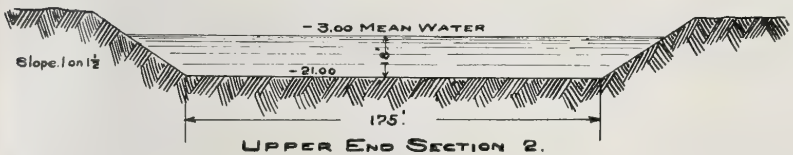
Bureau of Engineering
Buffalo, N.Y.



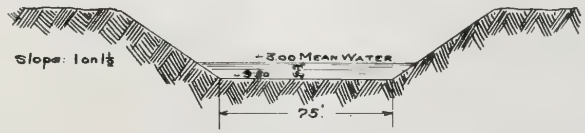
Lower End Section 2.
Hamburg St



Lower End Section 4
South Park Av

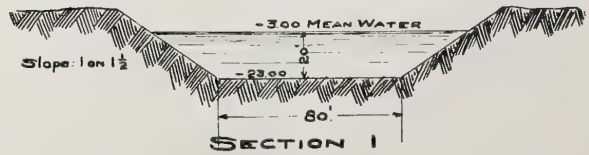


Upper End Section 2.
Bailey Av.

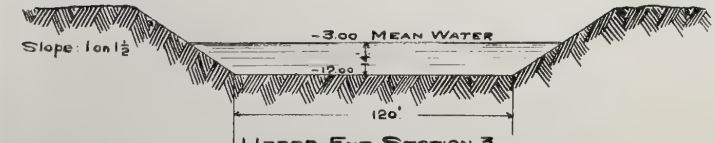


Upper End Section 4
Cazenovia St.

Lower End Section 3.
Seneca St



Section 1
Outlet.



Upper End Section 3.
City Line.

(Cut 6.)

The object of this construction is twofold, First: to collect all the waters of the stream in the channel to be provided below the weir. Second: To maintain the present flood conditions outside of the city in order to avoid any possible complications with other than city authorities. It may be stated right here that it is generally considered that a flood over such a valley as that of the Buffalo River, when the land is utilized for market garden purposes is not always an unmixed evil. A large portion of the territory inside of the city line, which is now made to suffer injury by the floods, was a few years ago cultivated and the soil probably much enriched by the annual floods. Anyway, it is concluded that the city authorities should confine their work to the territory controlled by them and it is even, with justice, I think, argued that the controlling works proposed at the city line should be paid for by the state authorities—the same being a work made necessary by waters furnished in superabundance by lands extending many miles beyond the city line and subject to the control of the state authorities.

From below the controlling weir a channel is to be excavated in the earth with a width on the bottom of 120 ft. and with banks sloping in a ratio of 1 to 1½—the elevation of the bottom of this channel being at the upper end—17 feet below city datum; this channel to be continued to the junction with Cazenovia Creek—a distance of 7600 feet, the elevation of the bottom at such junction being—21 feet (the diagrams, herwith, show section of the proposed channel and of the present channel) (Cuts 5, 6)

At Cazenovia St. on the Cazenovia Creek there is at present a dam which holds the waters back in an artificial lake in Cazenovia Park. This stream at this location is on a rock bottom and just below Cazenovia Street it is proposed to start a channel excavated in the rock to a depth of about 12 feet to the proposed channel bottom at an elevation of—9 feet city datum. This channel to be 75 ft. wide on bottom and of section as shown by the accompanying diagram. On another sheet, I have shown a section of the present channel of this stream. This section of channel proposed is continued to the junction with Buffalo River. From the junction of Cazenovia Creek with Buffalo River a channel is to be excavated 170 feet wide on the bottom, with sloping banks as shown by diagram of said channel and continued to the point of proposed outlet into the outer harbor, at which point the bottom is at an elevation of —23 ft. From this point, as indicated on the map, about op-

posite what is known as Farmers' Point, the channel is to be excavated in the sand and soft blue clay there existing across the narrow neck to the shore of the lake and carried out by pier protection to a depth of water of 18 ft.

The accompanying diagram shows a cross section of this channel.

The principal reason for the construction of the new outlet to the lake is because of the occasional uncertain conditions of the present outlet as to its ability to carry off the flood waters in case of ice and boat jams. Ice passing out of the mouth of the river is uncertain. With no wind, or with any but a southwest wind it is possible to keep an outlet open for the ice to reach the open waters at the head of Niagara River. With a strong southwest wind the broken ice around the mouth of the river is driven in and at once closes any outlet channel which may exist.

The effect of the new breakwater and improved channel towards Black Rock Harbor are as yet undetermined quantities.

The effects of gales on ice obstructions in the lower portion of the river are of as much concern to that portion as to the flooded area. The lower portion of the river will always remain an unsatisfactory outlet for large discharges of water and ice. It is obstructed by bridges and by many vessels moored along its frontage.

The separate outlet to the lake, as proposed, seems absolutely necessary to the proper and sure attaining of the desired object.

In studying the records of floods and flood results on the Buffalo River, I note that on February 9th, 1900, several large vessels on the lower river broke from their moorings, doing much damage to themselves and to bridges, and afterwards, with the flowing ice forming an obstruction which produced the highest flood elevation of years along the lower portion of the unimproved river.

A study of the situation seems to lead to the conclusion that such disasters cannot well be prevented if no other outlet than the present one is provided. This outlet entering the protected area inside of the outer breakwater might not be able to dispose of any large amount of flowing ice, as it will probably jam up against the heavy ice in the outer harbor, but even when completely jammed with ice, it will provide a partial outlet for flood flow and lessen the danger of floods from back water caused by obstructions in the old channel.

The fact that this new outlet is located some 10,800 ft. above the present outlet, and the new outlet being at the same level as the old, will necessarily increase the flood slope of the water by shortening the length of the flow from the city line to the lake. Without this outlet a rise of 4 ft. in the lake level will produce a rise at the junction with Cazenovia Creek—a distance of 24,600 ft. measured on the stream, of 2 1-10 ft. With the proposed cut-off to the lake, the same rise in lake level would produce a rise of only about 1.65 ft. at the junction.

The new channels proposed are all based on assumed maximum discharge of the Buffalo River of 25,000 cu. ft. per second, and a velocity of 5 ft. per second. This total discharge is a safe maximum, it probably being very nearly attained at least once a year, and is very seldom, if ever, exceeded.

The velocity of 5 ft. per second is considered safe for the banks, as proposed, inasmuch as it cannot exist but for a few hours in maximum flood, and at all other times is very much less.

I think that further details, such as bank protection, which is necessary at different points, bridge abutments, etc., would not be of especial interest in this connection and I will omit all that and refer anyone who is especially interested in the problem to the specifications prepared for the work by the Bureau of Engineering of the Department of Public Works, and to the very full report on the hydraulic problems involved, presented to the New York State Water Storage Commission by the local committee appointed by such commission and requested to present a study of the situation.

As a suggestion of the value of the proposed improvement beyond that suggested in the fore part of this talk, I would state, that before the location of the Lackawanna Steel Co's. plant just beyond the city line on the lake shore, land along the Ridge Road, which runs from the lake, parallel to the city line and just beyond it, sold for $300 per acre, or $1.00 per foot front on said Ridge Road. Since the location of the Steel Plant, land on this road has been selling for from $100 to $150 per foot front, or $30,000 per acre. Figuring an acre as having 300 ft. frontage, the average value of the land in this territory is now $5,000 per acre as against $300 three years ago.

With all of South Buffalo relieved from the inroads of Buffalo River and Cazenovia Creek and equipped with proper drainage,

which would then be possible, and also with several miles of available water front on the improved river, there would undoubtedly be as great an increase in values, for there would be no better location for manufacturing sites in or near the city.

That the work of abating the floods will go ahead in the near future seems to be assured by the earnestness of the people most seriously affected and those who will profit by the improvement.

The bids now before the Common Council and the report of the Commissioner of Public Works give assurance that the necessary work can be done at a cost that will not exceed the amount now available for the purpose.

The plans and specifications have been filed with the Chief of Engineers of the United States Army and are approved by the Secretary of War—Such approval is necessary for authority to change the alignment of the Buffalo River as proposed, the same being a navigable stream and, as such, under the jurisdiction of the Federal authorities.

C. M. Morse.

Buffalo, N. Y.,
April 3, 1903.

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VOL. VIII. No. 3.

ECONOMIC ZOÖLOGY.

READ BEFORE THE BUFFALO SOCIETY OF NATURAL SCIENCES, APRIL 10, 1903.

BY FRANKLIN W. BARROWS, M. D.

Some one has said that economic zoölogy is the study of animals from the standpoint of dollars and cents. It is this and more; for it includes the consideration of all the influences exerted by animals for the good or the ill of man, their reputed master. The object of the science, or perhaps it should be called the art, is the complete realization of our dominion over animals. The literature of the subject is found scattered through the reports of the various scientific departments of all governments. Probably a very fair idea of the present state of the subject can be obtained by consulting the reports of our own government.

Of the actual beginnings of economic zoölogy we know absolutely nothing. There is considerable evidence that the cave-dwellers used a variety of animals, including fishes, for food, but there is nothing to show that these primitive folk had established friendly relations with any of their animal neighbors. They clothed themselves in the skins of beasts and made rude tools from bones and horns, but it was evidently reserved for a later race to begin that long campaign of education which has given to us our domestic animals. With the taming and controlling of the

lower animals man himself progressed from barbarism to civilization, and it may safely be assumed today that the culture of a race is in direct proportion to their progress in the utilization and mastery of the animal world. In our brief consideration of man's present attainments along this line, it will be well to speak first of his mastery of domestic animals and then, of his dominion over untamed animals.

We know that the most familiar animals of the house and farm were first subjected to man somewhere on the Asiatic continent, but their origin and the date of their subjection are, in practically every case, mysteries beyond the power of the historian to solve. Certain it is, however, that man early acquired the art of improving the primitive stock by selective breeding, and thus began to develop under his own guidance the many varieties of breeds and strains that obtain today among all our domestic animals. Thus the exceedingly diverse varieties of pigeons, dogs, horses, cattle, etc., are the results of human design slowly and deliberately worked out in accordance with natural laws. Many of these varieties, such as the pouters, tumblers and fantails, among pigeons, and the poodles and bull-terriers among dogs, have been bred merely to suit the caprice of the fancier. In the majority of cases, however, the motive of the breeder has been purely economic and we of this century are literally "the heirs of all the ages" in our possession of so large a group of animal species won from their native state and developed to supply so perfectly so many of our needs. The dog has been adapted to the requirements of hunting, herding, policing, drawing burdens, and even of serving as the companion of man. Other animals have been bred for hunting and fishing—such as the ferrets, otters, cormorants, owls and falcons. Fifty years ago there were a half dozen breeds of chickens in the United States. Now there are over 100. At the same time the yearly number of eggs per hen has been increased from seventy-five to one hundred and seventy-five, according to Prof. G. P. Roberts, of Cornell University. The poultry breeder has produced varieties excelling also in quantity and quality of flesh and plumage, respectively, while he has utterly conquered the migratory instinct which was so strong in the original stock of our ducks, geese, and other fowls. The domestic pig weighs four

times as much as his wild relative, and has developed remarkable qualities of mind and body from his association with man. Among wild cattle the female produces just enough milk to suckle her calf, while the domestic breeds most famous as "milkers"—the Holsteins and Ayrshires—will yield their own weight in milk every twenty or thirty days. Both the quality of the milk and the period of lactation have also been immensely influenced by breeding. Other varieties of cattle, as the Durhams and Herefords, are bred for beef, while the Devons are noted for their excellent qualities as yoke oxen. Our modern horses, also, illustrate in many ways the art of the breeder. Originally serving man as a pack animal, the horse soon became the indispensable companion of the traveler and the merchant, and in course of time acquired a place of inestimable importance in warfare. The steed of the Norman knight was the noblest horse that the world had ever seen, and from him are descended the finest draught animals of the present day. Neither the Norman knight, however, or any of his contemporaries ever dreamed of the excitement of the modern race track, or fancied that the prize horses of the Derby would win their laurels by whisking a light-weight jockey around the circle in a ball-bearing sulky, and not, forsooth, by carrying a lusty baron and two hundredweight of armor in the tournament. Both in England and in this country the most careful attention has been given to increasing the speed of the horse. Seventy-five years ago the running record was three minutes. In 1865 Legal Tender ran in 1:44, a record that is equalled or excelled on every race-course in the country today. In 1843 a trotting record of 2:30 was established. In 1894, fifty years later, the number of horses on record that had trotted a mile in 2:30 or less was over 7,500, and rapidly increasing. Twenty-three horses at this date had records ranging from 2:04 (Nancy Hanks) to 2:10. Thus within the past century the American horsemen have developed a distinct breed of horses, and all by the persevering application of the principles of artificial selection for four or five successive generations. At the same time, we have not neglected the perpetuation and improvement of other serviceable breeds of horses, adapted to the plow and the road. The mule, a hybrid that owes its existence to the enterprise of the stock-breeder, is one of our

national resources, and St. Louis has the proud distinction of being the greatest market on earth for this animal.

While the present is an era of great accomplishments in the improvement of domestic animals, it must be admitted that few if any new species are being won from the wild state in this or other countries. The list of domestic animals remains about what it was two centuries or more ago; in fact, the falcon and other species that were once so generally employed in the sport of "hawking" have been allowed to return to the wilderness—the only case, according to Shaler, in which man has abandoned a species once domesticated. It is said that the camel is gradually retiring from active service for man, but it is not likely to be entirely superseded for many years to come. Even the horse and the dog are of less economic importance now than when they helped man to explore and colonize the vast wilderness of a few generations ago.

If our progress in the arts and industries has somewhat depreciated the value of a few of our domestic animals it has more than compensated for this depreciation by discovering new uses for animal products and thus vastly extending the utility of the animal kingdom as a whole. This age excels all others in the variety and extent of the services derived from animals. No animal product is wasted. Indeed, every item in the inventory has its market value today. It is not surprising, therefore, that the agricultural world devotes its best efforts to the problems of livestock. Our experiment stations in this and foreign countries, are investigating the food of farm animals in order to discover the proper dietary for the work-horse, the milch-cow, the porker, or the laying-hen. The agricultural chemist is studying the effect of different diets on the quality of manures produced and utilized on the farm. The Bureau of Animal Industries, an indispensable adjunct to the other activities of our United States Department of Agriculture, is investigating the vast field of diseases of domestic animals and experimenting on the means of preventing or curing them. Results of momentous significance have been attained in the study of trichina, Texas fever, hog cholera, tuberculosis, sheep-scab, tapeworms of poultry, and a host of other parasitic and infectious diseases which constantly prey upon our useful animals. It would be

interesting to recount a few of the methods used and the results obtained in these investigations, if the limits of this paper would allow. Suffice it to say that the means employed and the money expended in these researches have been amply justified by the results, not only in our own land, but the world over.

Twenty years ago the British kingdom was losing a million sheep annually from the disease called "liver-rot," and in the years 1879-80 the loss was over three million. The investigations of the royal commission charged with the study of this disease showed that it was due to a parasitic worm, and pointed the way to remedial measures that have materially reduced the pest and restored to England millions of dollars. A few years ago the British public became aroused on the importance of checking tuberculosis in cattle. A test of Queen Victoria's herd at Windsor Castle showed that ninety per cent of the animals were afflicted with the disease and indicated the necessity of an immediate campaign to save the cattle interests of the island. Today the English people are comparing statistics and they find that the British cow is yielding thirty per cent less milk than the cow of Denmark on the same quantity of food. Such instances serve to show the value of the scientific and statistical methods by which every country is extending its animal resources.

In our own country the total value of all farm animals in 1896 was reported at $1,997,000,000. Four years later, in 1900, $2,213,000,000. In 1891 our exports of farm products alone amounted to $950,000,000, and made up sixty-five per cent of our entire export trade. Of this amount, $250,000,000 worth consisted of animal products. To protect ourselves and our customers, the United States government, during this year, inspected a million and a half of cattle for Texas fever, and vaccinated thousands of cattle for black-leg. Out of a total of five million cattle inspected for various diseases, 12,500 were condemned. Out of 24,000,000 hogs inspected, 80,000 were condemned. These are but a few statistics showing the enormous extent of our animal industries and the degree to which we have developed our system of intelligent supervision.

Our government exhibits commendable enterprise, also, in the introduction and encouragement of new species of domestic ani-

mals. The establishment of the reindeer in Alaska, while its ultimate success is questionable, has proved of considerable value on several occasions. The government is introducing the Angora goat into regions where it promises to add materially to the resources of the farmer. The last report of the Secretary of Agriculture turns our attention to the development of the animal resources of our island possessions. In Hawaii, for example, it is reported that live hogs sell for ten to seventeen cents per pound, chickens for $15 per dozen and eggs for forty to fifty cents per dozen, all being in the category of luxuries. It is proposed to increase these products in the islands until they can be sold as cheaply as the common foods.

We will now consider that vast field of economic zoölogy including all those animals directly beneficial or injurious to the human race, which have not been domesticated to any extent. We shall see that in this field, also, the present age is making great conquests—and some sad mistakes as well. A mere enumeration of the animals in question would occupy more time than can be spared, and the characterization of their economic features must therefore be very brief and imperfect.

You have probably heard the ancient saying that Amsterdam is built on herring bones, and we could all of us name less conspicuous communities of our own acquaintance whose existence depends on fisheries and related industries. The British boast that every acre of water about their island is more productive of wealth than so much English soil. The German Ocean produces annually eight to twelve pounds of fish per acre, or a billion to a billion and a half of pounds in all, and the German government is laboring to increase this output several fold. The sturgeon fisheries of the Volga river employ a hundred thousand men. Two years ago the fisheries of the United States yielded a return of forty millions of dollars, and the oyster business alone was worth fourteen millions, and yet the country had to import fishery products to the value of six million dollars, most of which might as well have been produced in American waters. Every one knows something of the methods and results of the work of our national and state fish commissions, to whom is due most of the credit for the prosperous condition of our fisheries. Not only do they raise fish artificially

but they learn how to combat successfully some of the diseases and enemies that prey on our food fishes. America has the distinction of leading the world in the rearing and protection of fish. To show what one state can do in one year it may not be amiss to refer to the report of the New York state fish commission for 1898. In this year the state fish-car made forty-six trips, distributing thirty-five car loads of young fish throughout the state, and fifty carloads of fish were allowed to remain in the hatcheries for the next year's planting. The state expects to restock Lake Ontario with whitefish, and for this purpose hatched twenty million fry in one year. Our fish and game commissions frequently render good service by suggesting appropriate legislation and correcting faulty laws.

And now, to change the subject again, we shall not find in the whole range of animals another class of such power for good and evil as the insects. The time was, not many years ago, when the professional entomologist was dubbed a "bug-hunter" and regarded with undisguised contempt by the *"practical"* farmer and man of affairs. But the despised bugs kept rolling up accounts against our people and collecting them regularly, annually destroying agricultural products valued at $100,000,000 to $300,000,000. Our people set the bug hunter to devising some sort of relief from the insect plague, and the science of economic entomology was brought from Europe to America. Like many other things introduced from the old world, it has developed beyond all previous bounds and now America leads the world, without a rival in the science of applied entomology. The present indictment against insects consists of five counts and is well enough expressed in the words that I shall quote from Dr. Howard, the United States Entomologist.

"Insects are injurious:

1. As destroyers of crops and other valuable plant life. 2. As destroyers of stored foods, dwellings, clothes, books, etc. 3. As injuring live stock and other useful animals. 4. As annoying man. 5. As carriers of disease."

Another quotation shows the possibilities of these pests when acting in the first named role:

"At the present time almost every cultivated crop has not only its thousands upon thousands of individual insect enemies, but it is affected by scores and even hundreds of species. A mere

tabulation of the insect enemies of the apple already recognized in this country shows 281 species, of clover 82 species, and of so new a crop as the sugar beet 70 species. The insects of the vine, of the orange, of the wheat crop, and, in fact, of all of our prominent staples, show equally startling figures."

In another place Dr. Howard quotes statistics showing that half the cattle received at the Union Stock Yards of Chicago in 1889, were afflicted with the ox bot fly, or ox warble, resulting in an actual loss of over three million dollars in six months from that one insect alone. Instances of insect ravages might easily be multiplied *ad infinitum*. The only redeeming feature of this situation is the wonderful industry of our scientists, who in all parts of the world, have studied the problems of fighting and exterminating the foe. The public has been educated, also, in a few of the fundamental principles of economic entomology, especially in regard to the value of birds in combating insects. We are becoming more than ever impressed with the dangerous character of flies and mosquitoes. Experiments in the eradication of mosquitoes have been carried on in many parts of the country. We all know what has already been done along this line in some tropical regions. Reference will be made in another paragraph to the extraordinary battle waged in California against the scale insects. Indeed, we may say, in summing up this part of the subject, that no warfare was ever more scientifically waged than the present warfare of civilization against noxious insects, allowing, of course, that there is still ample room for improvement.

But there is another side, a brighter side, to the insect question. Dr. Howard says:

"Insects are beneficial: 1. As destroyers of injurious insects. 2. As destroyers of noxious plants. 3. As pollenizers of plants. 4. As scavengers. 5. As makers of soil. 6. As food (both for man and for poultry, song birds and food fishes) and as clothing, and as used in the arts."

It is needless to add that our Department of Agriculture, under the lead of such experts as the late Dr. Riley and Dr. Howard, whom I have just quoted, has spared no efforts to reap a profit from the insect world wherever possible. These men have raised the science of economic entomology to a position of inter-

national importance through their most gratifying success in destroying our injurious insects by importations of their enemies from foreign countries. Experiments in this line began as many as thirty years ago, but, as Howard says, these were all "dwarfed into insignificance by the astounding success of the importation of *Novius (Vedalia) cardinalis,* a ladybird beetle, from Australia into California in 1889." I will condense Howard's interesting account of this and similar importations.

The citrus crops of California were suffering from the ravages of the white or fluted scale, a very small insect, which successfully resisted all measures employed against it, until it seemed that nothing could rescue the orange groves from certain destruction. At this juncture an *attaché* of the United States Division of Entomology visited Australia and succeeded in sending live beetles to California. Here they made themselves at home, multiplying with astonishing fecundity and attacking the scale insects so voraciously that within a few years they had literally exterminated them, and saved to the citrus industries of California, millions of dollars. Later, the United States entomologist had the pleasure of introducing the same beetle from California into South Africa, Egypt and Portugal, in each of which localities it was successful in combating the white scale. Another ladybird beetle imported into California "has unquestionably ridden many olive groves of the destructive black scale, and is today present in many other orchards in such numbers that the scale practically makes no headway." Many other experiments of this sort are under way in this country, and the efficacy of insect importations has been successfully tested in Hawaii and other lands.

The last annual report of the United States Secretary of Agriculture announces the success of another importation, a most unique experiment, the scene of which lies in California. For several years the fruit growers had attempted to raise Smyrna figs in California, without success. About six years ago the Division of Entomology determined to introduce from the Mediterranean country a little insect, *Blastophaga grossorum,* which there performs the very essential function of pollenizing the fig. After four or five generations of this fertilizing insect had been reared at Fresno, it became evident that it would supply the only factor lacking for

the successful growing of figs. And now the "Smyrna figs" of the Pacific Coast bid fair to take their rank along with the standard figs of commerce. The United States entomologist is prepared to furnish colonies of these precious insects to all intending fig growers.

In the few instances just described we behold the realization of one of the chief ideals of economic biology—the subjection of useful species to the will of man.

Many insects might be named which are of great value in agriculture and commerce. We think at once of the silk-worm, which, as Professor Shaler remarks, is of more importance to us than the elephant, because it supports an industry out of which ten millions of human beings get their living. The bee is busy all over the earth, furnishing annually ten thousand tons of honey besides a valuable output of wax. The cochineal bug of the tropics, from which we derive our supply of carmine, once outranked all other insects in the commercial value of its product. Now, however, the aniline colors have largely superseded carmine.

Lest this paper should become merely a catalogue, we will spare you the repetition of a score or more of useful insects, merely remarking that possibly this class of animals comprises among its millions of species more friends than foes.

The birds undoubtedly rank next to the insects in economic importance. Nearly all of them are useful to man. A recent writer says that if all our native birds were to be destroyed man would die of starvation inside of ten years; mainly because of the unchecked increase of the insects that destroy our food plants. However this may be, we know that civilization is coming to a realizing sense of its dependance on birds in the war against noxious animals and weeds. This rational attitude toward our birds is due largely to the careful investigations of bird habits in every country of the first rank, particularly in our own land. The study of the relation of birds to agriculture has been very thoroughly cultivated by the United States Department of Agriculture, involving, among other methods, the investigation of the contents of about 20,000 birds' stomachs, and the careful tabulation of the articles of diet. The report published in 1899 states that only six or eight of our native American birds are found to be injurious to man. The

English sparrow and a few hawks and owls are condemned to extermination by this verdict of the department, while, on the other hand, some species formerly considered noxious are found to be decidedly useful. Everybody knows something about the campaign against the use of birds for millinery, and the measure of support that it has received. Our government and the various states are slowly modifying their legislation and coming to a more rational way of dealing with this question. Hereafter questions involving the welfare of any of our birds are likely to be referred to experts and not left entirely to the whims of the selfish or the tender mercies of the careless.

Of the higher animals, the mammals, there are scores of species whose value is well known. We need merely to mention the fur-bearing beasts, and our game animals to recall many species to mind. Of these, one and all, we confess in truth that we have sinned against them, and are reaping the results of our folly in a threatened extermination of some of the most valuable. The law makers are proverbially slow in acting where the fate of wild animals is concerned, as is too well seen in the case of the fur seal, the buffalo, and many kinds of wild game. Public opinion, however, is becoming stronger and with the help and backing of such organizations as the League of American Sportsmen it is likely to create gradually better conditions for all the animals that are hunted. The passing of the fur animals of the north has given a market value to such inferior pelts as those of cats, squirrels, rabbits and rats. The breeding of the Arctic fox promises to become a very productive industry in Alaska. As for leather, there seems to be no sort of hide from which it is not prepared today, from the skin of the eel to that of the elephant.

The discussion of our topic would be incomplete without mention of some of the blunders that man has made in his efforts to make himself master of the situation. The greatest of these, is the oft repeated sin of extermination. Something like a score of species were exterminated by man's misdirected industry during the nineteenth century, and many other species were so hard pressed that their disappearance from earth seems a question of a few years.

Another mistake that man has repeated often with disastrous results is the disturbance of the balance of nature by the intro-

duction of wild animals from one country to another. The case of the mongoose in Jamaica is a good illustration, and so well known that it needs but a word of explanation. This mammal was brought from India to rid Jamaica of its pest of rats. Being free from its natural enemies, against which it had always competed in India, it soon became more of a nuisance than the rats that it had supplanted—in fact it completely upset the balance of nature, until the government of the island offered a bounty on its head. In spite of this unsavory chapter of natural history, it has required the most vigilant and determined opposition on the part of the United States government to prevent the importation of the mongoose by certain well meaning people, to the southern states and to Hawaii. Australia has suffered the loss of millions of dollars by the introduction of rabbits from England, merely to furnish game for hunting. The English sparrow came to America, by invitation, in 1850. We all know the result. The gypsy moth was turned loose in Massachusetts in 1868 or '69, by an innocent experimenter who wished to test its silk making powers. In twenty years the state government began the task of exterminating the moth, and now, after expending several millions of dollars, it finds the moth slightly ahead in the race. It is not strange that some of our scientific experts are trying to secure legislation that shall make it a criminal offense to bring into the country any foreign animal without the consent of some regularly constituted authority.

The future of economic zoölogy is filled with marvellous possibilities, and bright with promise. Applied zoölogy has taken its place among the arts and sciences of this progressive age and it has its skilled experts, its laboratories, its problems, and its solution of some of the vexatious questions of the day. Every fish hatchery, every experimental station, every agricultural college, and in a growing degree, every biological laboratory in the world, is a center for the prosecution of research and experiment in this vast field. Every discovery in biology, however impractical and trivial it may at first appear, conduces to some new triumph of man over the plastic forces of the animate world. Let us now consider a few of the lines along which the future achievements of this science are likely to be worked out.

1. We shall put a stop to the ruthless slaughter of our wild

animals wherever a civilized government has its "sphere of influence." We are likely to go still further in this direction and to set aside parts of the national domain as permanent parks in which every form of life shall be absolutely safe from man's marauding hand. Our own government has made a good beginning in the Yellowstone National Park. It remains now to secure tracts of available wilderness east of the Mississippi, and on the Pacific Coast. These reservations may be made valuable as forestry preserves, thus serving for all time a double purpose. Some of our states have made beginnings in this work, but we need more extensive reservations under federal control. The movement recently sanctioned by Mr. Hornaday, of New York city—the setting apart of a magnificent national reserve in southern Alaska, should be consummated without delay. We shall then have a place of refuge for the most superb mammals of the continent—the buffalo, musk ox, various species of bear, the beaver, many of the choicest fur-bearing animals, etc. It is a wise provision of Providence that has placed the noblest fauna of North America in our own domain and in a part of it that offers few temptations to the farmer or the miner. We shall certainly be very remiss if we fail to set apart and patrol this last refuge of the animals that are now hunted to the death.

Other countries are moving in this matter; even in Africa the protection of wild animals is to be undertaken by the powers. A convention signed by all the leading governments of Europe about three years ago, makes rigid restrictions on the hunting of game in Africa, and among other agreements, binds the signatory powers to encourage the domestication of the zebra, elephant, ostrich, etc., to prevent the transmission of diseases from tame to wild animals, to destroy the eggs of crocodiles, poisonous snakes, pythons, and in many other ways to render service to the useful or harmless animals that are in greater danger of extermination.

2. The most inviting service that awaits the energies of the economic zoölogist is the seeking out of new species of animals that shall be made useful to man in some new way. The number of animals that we utilize at present is surprisingly small. The total of animal species classified and named by our scholars was estimated at over 71,000 in the year 1830; 50 years later, in 1881,

there were over 311,000; while in 1896 there were said to be 366,000 species of animals having scientific names and recorded in the books. It is popularly believed that Adam finished the business of naming the animals before he left his residence in Eden, but we see from the figures just quoted that our own contemporaries found and named in the last three-quarters of the nineteenth century nearly 300,000 that Adam in his hurry had overlooked. And lest any one should think that the task was completed by the dawn of the twentieth century, we are told that the sum total of animal species is probably no less than ten millions. Indeed, Dr. Riley, once U. S. entomologist, estimated the varieties of insects alone at ten millions, which would bring up the sum of all animal species to fifteen millions. There remain, therefore, between nine million and fourteen million species still nameless—enough to furnish occupation for a long time to those who like that sort of thing. The real question, the main question now, is, What is the place of this species in the economy of nature? Is it injurious to the interests of man? If not, can we turn it to account in any way? The number of animals utilized by man is small, ridiculously small, it would seem. Shaler says that we use only 100 animals and 1,000 plants out of millions of species. Only twelve insects, he tells us, are used directly by man, and only two of these, the bee and the silk worm, can be called domesticated. America, the scene of so many of the latest triumphs of economic zoölogy, has added only one animal "of definite use to man over a wide field," to the list of domestic animals; and that is the turkey, which, by the way, became domesticated in Europe and was brought back again to its old home. These are the statements made by Shaler. It is true that we are now domesticating the buffalo, but with rather doubtful success. Peter Kalm, who visited this country in 1750, speaks of seeing domestic buffalo here. The early settlers of this country had their schemes for domesticating the moose, but they never accomplished the work. Other continents, also, have their unimproved opportunities. In Africa the breeding of zebroids, crosses between horses and the native zebras, promises to revolutionize the horse question. The bare possibility of originating on African soil a hybrid that shall compete successfully with the imported American mule, sheds great hope on the life of a South African, what-

ever his politics may be. So, indeed, the discovery of a single useful species, or the finding of a new use for an already serviceable animal, may be the means of adding millions to the revenues of a nation. No country can consider the exploitation of its animal resources completed until it has thus pressed the last recruit into its services and developed it to its highest capacity.

3. This brings us to the last and highest ideal to be sought in our use and treatment of animals, namely, the development of a stronger sympathy between us and our dumb friends by educating not only them but ourselves as well. Professor Shaler, in his convincing way, shows us that the animals most companionable with man have developed human qualities of mind by long processes of artificial selection. This is illustrated in what we all recognize as a well-bred dog; and who of us does not recognize a well-bred dog as instinctively as a well-bred man? That the domestic animal should become assimilated, in mental traits, to its lord and master is as fortunate as it is natural, for it opens up to us immense possibilities. If in the future as much attention shall be given to the improvement of animals in this line as in the past we have bestowed on the development of certain physical "points" in every breed of dogs or horses or pigeons, we may expect to bring our animals into more helpful and affectionate relationships with us than ever before. Indeed, such a result is inevitable as surely as it is ever attempted by the scientific breeder. If you find your dog companionable in your romps through the country or in the quieter hours that you spend at the fireside, why shall not his descendants in future ages be still more worthy to associate on terms of intimacy with the very best families? Have we ever thought of the possible social status of some of our dumb friends, a few centuries hence?

They say that "slumming" has a most wholesome influence on the social missionary. By a sort of natural reciprocity he receives from his lowly environment as much as he gives, and so he develops a fine personality while sacrificing himself for others. It is equally true that if we adopt the honest and human attitude toward the animals, using them for our convenience, if we choose, but treating them always with the consideration due to every fellow creature, we shall minister to the development of our

own characters. This high philosophy is not inconsistent with the proper use of animals in any kind of service, nor does it prevent the destroying of those forms that torment ourselves or our animal friends. In some countries, as, for example, India, many forms of animals are deified, housed in temples, worshiped, and regarded with such awe that no one dares to kill one of them even to put it out of extreme misery. Yet our own people are much more humane than these worshipers of animals, and without any of their befogging and heathenish philosophy. As we extend our power over the animals it will ever be with a growing sense of respect for their myriad forms, and a corresponding sense of our own responsibility to their Creator and ours for the way in which we exercise our undivided dominion.

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A REVIEW OF THE WORK DONE BY THE BUFFALO SOCIETY OF NATURAL SCIENCES IN CO-OPERATION WITH THE PUBLIC SCHOOLS.

by

Carlos Emmons Cummings

A. B., M. D.

Secretary of the Buffalo Society of Natural Sciences

BUFFALO 1906

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CARLOS EMMONS CUMMINGS, A. B., M. D.

Secretary *of the* Buffalo Society *of* Natural Sciences

From the day of its inception, one fundamental principle has controlled the policy of the Buffalo Society of Natural Sciences. Realizing the important place which a great museum must eventually take in the educational system of its home town, we have always endeavored to get into the closest and most effective relationship with the public schools of our city. Every facility which we had to offer to the student has been freely and continuously placed at his command. For years the science teachers of the city have been in the habit of bringing their classes to our building, and we have supplied them with room and materials for their work. In the study of geology, thousands of high school pupils have received great benefit from our collections of rocks and minerals, and our display of native birds and animals has been of the greatest help to the classes in zoology and natural history.

At the beginning, it was the custom for the teachers to accompany the classes and take charge of their work while here, the museum offering simply its collections and rooms, no attempt being made to provide lectures or instruction beyond what was displayed. In time, however it was found that certain topics were of such universal interest that they would warrant special attention, and so the plan of special lectures for the schools came into being. A series of talks on "Bees", "Birds" and "Insects" was arranged for Saturday afternoons, and were open to such of the grades as cared to come, and met with much success. The atten-

dance at these talks was entirely optional with the classes, the Department of Education simply recommending that as many schools as possible take advantage of them.

As a part of the work, it was expected that the classes which came to the talks would take the opportunity of visiting all the rooms of the museum, and in this way become acquainted with the fact that there were here displayed for their benefit many interesting and valuable specimens illustrating topics which would be an important part of their later studies along scientific lines. As a further inducement to the schools to come to our museum, the large lecture room was equipped with a suitable apparatus for the projection of slides, and this was announced as being available for any school or class that cared to come and bring slides to illustrate a talk by the principal or teacher. For some months this room was in nearly constant use by the schools, the teachers coming with the classes and making whatever explanation was necessary as the pictures were thrown on the screen by the operator. In one series given to the third and fourth grades, on geography, over 14000 children attended. Shortly, however, after this plan had been inaugurated, the Department of Education considered it advisable to equip nearly all the schools with lanterns, and therefore at this time only a few schools are under the necessity of coming to our rooms when they wish to display slides to their classes.

In the spring of 1905, through the efforts of Hon. T. Guilford Smith, the President of the Society, a plan was arranged with the Department of Education by which our Museum became an important factor in the work as required from the pupils of the grammar grades. A suitable collection to illustrate the weapons and utensils of the colonial days, used by Indians and whites, was arranged, and notice was sent to all classes studying American History that these things were on exhibit for the schools, and could be seen by applying at the Museum for a suitable hour to be assigned. It was expected that the teachers would bring their classes and explain the utensils and other interesting specimens to the classes from the cases. This plan did not meet with great enthusiasm. The teachers, already having as much special work as they could be reasonably expected to carry, preferred having some one else give the talks, and Dr. Carlos E. Cummings, the Secretary of the Society, was asked to take this matter in charge. This being done, the visits of the schools took the nature of regular

Carlos Emmons Cummings, A. B., M. D.

Secretary of the Buffalo Society of Natural Sciences

lectures, and met with great and immediate success. Although attendance was not required, so many teachers applied for dates that in this course, as can be seen in the appendix, thirty five separate lectures were given, to an attendance of nearly 5000 children. These talks were followed by a series on birds and bees to the seventh grade, thirty lectures in all, to an attendance of 6700.

During the summer arrangements were perfected to make this work an integral part of the public school requirements. The Department of Education decided to make the attendance upon these talks compulsory on those classes included in the grammar grades, and the Society secured the services of Dr. Cummings for the following year. He has since had charge of this work, giving all the talks and preparing all the material used in illustrating. Regular schedules were prepared by the Department of Education, and sent to all the principals, notifying them upon what day to send their classes, and the Society also sends to each principal a card announcing the lecture so that any alterations or changes in the schedule can be arranged for. At the end of each course supplementary lectures are given to accomodate those schools which for any reason have been unable to come at the scheduled date. As a convenience in keeping the records of each course, each teacher is expected to register at the time of the talk her name, the school she represents and the number of boys and girls she has with her.

A great part of the work of the Secretary is taken up in preparing the material used in illustrating the talks. Lantern slides are used freely. To facilitate the manufacture of these pictures, a dark room was fitted up, and materials secured, and we now have available a considerable number of slides, and more are being constantly added. Within the year nearly six hundred slides have been made here in the museum, and the files include over a thousand negatives that can be made up on short notice if needed. (For a complete list of slides on hand, see Appendix D). A trip to Jamaica during the month of April yielded nearly 500 negatives, (vide Appendix B), and a visit to the copper country of Lake Superior furnished some valuable material (Appendix C).

Series I. was illustrated by a fine collection of relics and material borrowed, as well as that in the cases of the Museum. The boys were particularly attracted by the exhibit of guns and weapons, while the girls showed more enthusiasm over the spinning wheels and articles of housewifery. This series was repeated

to the eighth grade, using the same material. No slides were shown in these courses.

In the bird talks, actual specimens of the birds described in Mr. Burroughs' splendid stories were shown, and then a series of pictures was thrown on the screen showing the homes of the birds and the enemies which are liable to attack them. These talks were possibly the most popular of any given. For illustrating the bee talks a hive of live bees was secured, the walls of the hive being made of glass so that the bees and comb can be plainly seen. Another empty hive was used, to show the frames, comb, queen cells, and general arrangement. A full set of bee-keeping utensils gave the children an idea of the methods used by the bee-keeper in handling his charges, and with the help of the slides, many features of the anatomy, as well as the customs and habits of the bee were explained. Two cases were arranged, one showing a fairly complete series of the mineral products of the United States in the crude state, and these were used in the lectures to the fifth grade children. Similar cases showed tropical products, notably cocoa, vanilla, cocoanuts, coffee and rubber, and were used in the sixth grade work. The fine slides illustrative of Jamaica products will be available in addition for the work next year. The Physiology talks were an effort to perform for the children the experiments required in the new physiology syllabus, with suitable explanation, and were so successful that at the request of the teachers, an evening was arranged for them alone, at which time they were at liberty to ask questions of the lecturer in regard to the work, and the methods of performing the experiments before their classes. Although the talks were given during the required school hours, and attendance was in a sense compulsory, it has been found that both teachers and children have taken the greatest interest in the work. One boy last year came three different times to the bird talks and several teachers requested the privilege of bringing their classes a second time. In a few of the courses the lectures were announced to the teachers at grade meeting, and they were asked to register their schools, if they cared to have their classes attend. In every case nearly every teacher registered immediately or shortly after the beginning of the series. The lectures are given at 10:30 and at 2:00, the schedule being arranged so that those schools situated the farthest from the museum have an afternoon assignment. This prevents any necessity for hurry in getting back to school

for an afternoon session. The attendance at the talks has averaged about 125, the number being purposely made small so as to make them as informal as possible and to encourage the children to ask questions as well as answer them on the topics presented.

A report of this kind would be quite incomplete were not some acknowledgement made to the officers of the Society by whose persistent and effective efforts our present effective system has been developed. Among these are the late Dr. William C. Barrett, one-time Director of the Museum of our Society; Mr. Frederick Houghton, who was responsible for the travelling exhibit scheme, which is now being taken up by the large museums of the country; Dr. Lee H. Smith, for many years the President of the Society, under whose administration the lectures were brought to a systematic basis; Dr. Elizabeth J. Letson, the efficient Director of the Museum, on whose shoulders the greater part of the routine in arranging the work has fallen; and Mr. Henry Richmond, Chairman of the Education Committee, who has been largely instrumental in getting recognition and assistance from the City in carrying on the work. It is with particular pleasure that the Society acknowledges here its great obligation to the Hon. T. Guilford Smith, Member of the Board of Regents of the University of the State of New York and President of the Buffalo Society of Natural Sciences since 1903. Although closely connected with nearly every public movement that concerns the best interests of our City, Mr. Smith has found time to place our Society on its present high level of efficiency. Believing firmly that in co-operation only can the best results be secured, he has succeeded in associating all the various and disconnected interests represented in the school work, making them one and uniform, working to a common end, and accomplishing an amount of good which is most remarkable considering the unfortunately limited facilities of the Society at the present time.

COCOON OF ATTACUS CECROPIA

BREAD FRUIT TREE

CAPTAIN L. G. BAKER
The Father of the Jamaica Fruit Industry

GROWING BANANAS, JAMAICA

Appendix A

Schedule of Lectures delivered to grammar grades, 1905–6.

No.	Subject	Grade	Date begun		Date ended	Number of Lectures	Attendance
I	Colonial and Indian customs	9	March 21	to	March 31	18	1950
II	"	8	April 5	to	April 24	17	3000
III	Birds	7	April 24	to	May 8	15	3360
IV	Bees	7	May 22	to	June 5	15	3350
	Summer vacation.						
V	Birds	7	Oct. 16	to	Nov. 2	26	2997
VI	Mineral products, U. S.	5	Nov. 13	to	Dec. 21	40	3732
VII	Physiology	9	Jan. 3	to	Jan. 5	5	162
VIII	South American products	6	Jan. 10	to	March 1	45	3909
VII	(continued)	9	March 1	to	April 1	16	1743
IX	Bees	7	May 14	to	June 1	23	2780
9		5				220	26983

Appendix B

To the President,

and Board of Managers of the

Buffalo Society of Natural Sciences:

I have the honor to submit to you the following report of my trip to Jamaica, W. I., undertaken in the interests of your Society.

Leaving Buffalo April 2, 1906, I proceeded direct to Philadelphia. Here I spent a day with Dr. W. P. Wilson, of the Philadelphia Museums, and was entertained by him in a most cordial fashion, being personally shown through the buildings, and obtaining from him a detailed descrip ion of the work being done in that city in connection with the school department. I also visited the Academy of Natural Sciences of Philadelphia, spending several delightful hours in examining their magnificent collections.

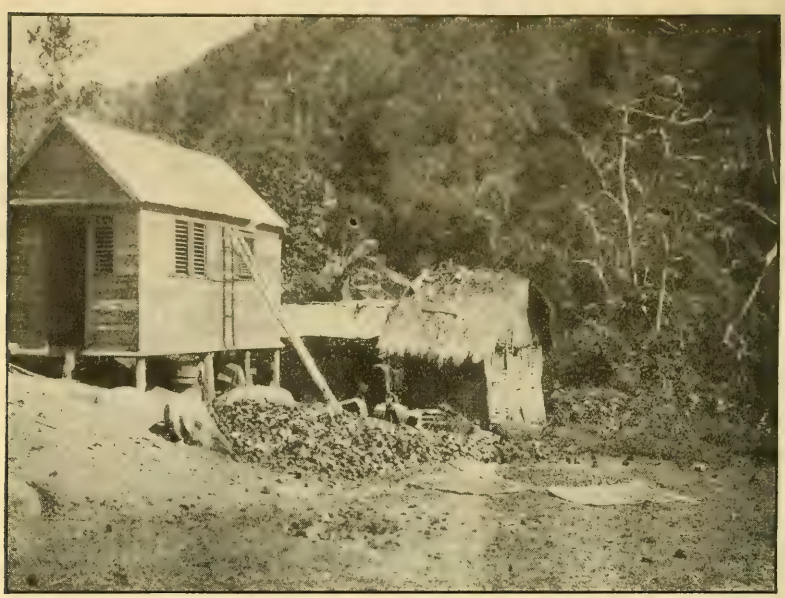
CACAO PODS, JAMAICA

COCOANUTS ON THE TREE, JAMAICA

I sailed for Jamaica on the 'Admiral Samson' of the U. F. Co's Line on Thursday, April 6. Apart from the first day, which was quite rough, the weather during the five days on board was ideal. Port Antonio was reached on Monday morning, and immediately on landing I secured rooms at the Tichfield Hotel. The first day was spent in unpacking and looking about the town, which affords a multitude of interesting features to the tourist

The next morning was taken up by a drive to Blue Hole, where we had our first experience with freshly gathered cocoanuts. Being prepared to appreciate this highly exploited feature of the tropics, its lack of any particular individuality was rather disappointing. Here is located one of the innumerable stations of the United Fruit Company, and we watched with great interest the process of loading bananas on the small sail boats to be transported to Port Antonio. In the afternoon a drive was taken to St. Margaret's Bay, and on the following morning Windsor and Mooretown were visited. Here we saw and photographed many cacao plants, as well as the ever present banana and cocoa palm. The afternoon being quite rainy, advantage was taken of the opportunity to photograph a series of tropical fruits in the freshly gathered state. Thursday morning was given over to a trip by carriage to Annotto Bay, which place we reached about three in the afternoon. Owing to the intense heat, and the very interesting nature of the place wherein we found ourselves, it was decided to remain there until the next morning. The afternoon was spent in a study of the methods of gathering and loading bananas, this being one of the principal shipping stations of the U. F. Co. Leaving Annotto Bay Good Friday Morning, the drive continued over the magnificent Blue Mountains, through plantations of banana, cacao and cocoa palms, to Castleton Gardens. Here lunch was obtained, and at three in the afternoon the Constant Spring Hotel was reached. This Hotel being but a short ride from Kingston by trolley, it was made headquarters during the remainder of the trip, as the temperature in Kingston is rather trying during the day.

Saturday morning I visited Kingston Institute, and was disappointed in not seeing Mr. Cundall, the Secretary in charge, for whom I left a card with my address. After carefully examining the collections in the Museum, I returned to the Hotel, and in the afternoon a drive was taken to Hope Gardens, where I added several negatives to my series of pictures on the tropical fruits



CURING CACAO IN THE SUN, JAMAICA

SUGAR CANE, JAMAICA

and products. Particularly was I pleased to secure views of growing vanilla and sugar cane.

Easter Sunday was devoted to a drive to Spanish Town and Bog Walk. The day was cloudy, and apart from a considerable series of banana pictures, nothing of particular value was secured.

Monday was rainy, and we were quite satisfied to rest throughout the day, remaining quietly at the Hotel. The next morning a trip to the Mona Sugar Estate yielded a splendid series of photographs of cane, and other features connected with the production of sugar and rum. Returning to Kingston, we went to the wharf to see off some of the party, and then I went to the Institute and arranged to lecture there on the following Saturday evening.

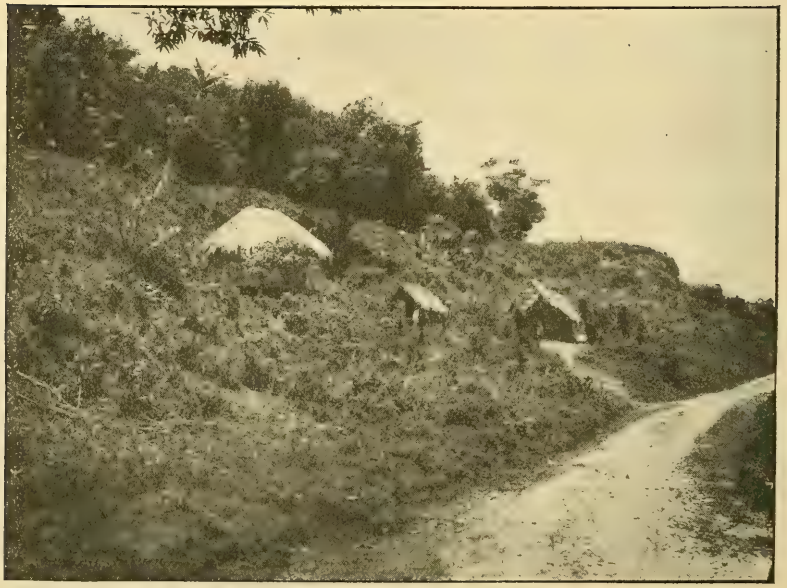
The next morning, after a very early breakfast, we took the train to Mandeville. Alighting at Williamsfield, a three mile drive brought us to the Hotel, in a most picturesque location. Mandeville lies in the centre of the coffee and orange district. We had no more than finished our dinner when we were assailed by a most terrific hail storm. It was a most amusing sight to see the natives scrambling around gathering the little lumps of ice, and I was assured by the propietor of the hotel that they had never seen any ice before that was not manufactured. At any rate, they watched the little masses melt in their fingers with the most intense interest. The rain continued until dark, when the stars came out in great brilliancy.

Thursday morning, after a five mile drive through a country which seemed to produce oranges by the ton, we reached the Brokenhurst Coffee estate, where we were met by the overseer and conducted through the mills. I secured a fine series of coffee pictures, but the season being past was unable to get as fine a collection of pictures of the berry as I would have liked. Immediately on reaching the Hotel, the rain began, and continued till dark, as on the first day.

Bel re tiro, an estate given over largely to the production of pimento, was visited the next morning. The estate is up on the mountains, and the view from the verandah of the house is unsurpassed on the Island. Owing to the almost continual rain, all the plates that I had with me at this place became damp, and my pictures taken here were not satisfactory The afternoon rain came on promptly according to schedule, and lasted till dark, as usual.

The next morning we arose at 4.30, and after a most delightful drive over the mist covered mountains, arrived at Williams-

MOORETOWN, JAMAICA



NATIVE HUTS NEAR WINDSOR, JAMAICA

field in time for the early train. Kingston was reached without incident, and in the afternoon I visited the institute and made final arrangements for my lecture in the evening. Owing to a rather exaggerated participation in oranges at Mandeville I was feeling rather 'seedy', as the hotel clerk expressed it, but was able to hold up till my lecture was over, and then promptly collapsed on reaching the hotel. I remained in bed the following day, Sunday, and on Monday devoted what little energy I had left to packing up my property.

The boat left Kingston at 1 P. M. on the following day. After stopping at Morant Bay, where to my regret I found it too late in the day to secure good pictures of the bananas being taken aboard, we cleared for Boston at one o'clock in the morning, all hands aboard. Two days on the water completely dissipated my indisposition, and Boston was safely reached at twelve o'clock on the following Sunday night.

We landed at seven o'clock on Monday morning, and after spending two days in visiting the innumerable points of interest about the city returned to Buffalo.

On unpacking my trunks at the hotel I found that owing to somebody's carelessness my trunk had been standing in several inches of water for some days, and as a result a quantity of specimens of tropical fruits, etc., that I was bringing to the Museum were mouldy. However I succeeded in getting safely here specimens of cocoa, cane, cocoanut, tobacco, ginger and others of interest.

My pictures, however, with one or two exceptions, were good. I secured in all something over four hundred negatives, most of which have been made up into slides and added to our collection.

Among the slides may be mentioned the following:

A series of twenty on banana culture and shipping.

A series of thirty two on native fruits, showing plant, form and structure of the fruit.

A series on sugar, showing canes, wagons used in hauling, crushing mill, boiling house, etc.

CANE FIELD, JAMAICA

A series on coffee, showing the plant, blossom, berry and apparatus used in curing.

A series on cacao, showing tree, pod, sectioned pods, native methods of preparation, etc.

A series on the cocoa palm, showing tree, nuts and leaves.

A series on tropical scenery and vegetation.

A series showing native customs and habits.

Very respectfully submitted,

Carlos E. Cummings, M. D.,

Secretary.

Appendix C

To the President,

and Board of Managers of the

Buffalo Society of Natural Sciences.

GENTLEMEN:

I respectfully submit to you the following report of the trip taken by me to the copper country of Lake Superior. I left Buffalo on the steamship Juniata, Sunday, June 17th, 1906. The trip up the lakes was not particularly pleasant owing to the fact that the first four days were marred by nearly continuous rain I was therefore, unable to procure very many photographs of the boats and ore docks which I especially desired to use in illustrating the shipping and handling of the ore. I left the boat at Houghton, Michigan. I had the pleasure of meeting Dr. Koenig of Philadelphia who occupies a position as Professor of Chemistry in the Michigan School of Mines at that place. I spent a very pleasant evening with him discussing the geology and conditions of the mines and obtained much valuable information.

The following day I visited Isle Royal mine in the morning and by presenting the letter of introduction which you very kindly furnished me before starting, I secured the attention and courtesy of the foreman of the shaft who very kindly allowed me to select such specimens as I desired and who gave me several interesting pieces which he had gathered for his own use. I brought back from this shaft some pieces of the Amygbaloid and Epidote and a very fine mass of Metallic copper with other specimens illustrating the nature of the ore produced at this time. Owing to the continual rain of this day I was unable to procure photographs of the shaft or machinery. In the afternoon, the weather having cleared, I visited the stamp mine of the same company and met with every courtesy, being shown through the different buildings and having the process thoroughly explained to me. I secured here specimens of the concentrates and some very fine samples showing metallic copper and metallic silver in the same piece. I secured photographs at this time illustrating the appearance of the buildings, the cars in which the ore is carried, and the disposal of the sand from which the copper has been extracted.

SHAFT HOUSE, RED JACKET MINE, CALUMET PROPERTIES

COPPER INGOTS ON THE DOCK AT HOUGHTON, MICH.

The following day I had the pleasure of accompanying Dr. Koenig to the Calumet properties where we visited the shafts and buildings of the Red Jacket and Tamarack No. 4. We procured here specimens of the cement copper and conglomerate or pudding stone deposits which illustrate quite satisfactorily the form of the metal produced here. A very pretty specimen of Azurite and Malachite was secured at the Red Jacket mine. A careful study was made of the machinery used in raising and crushing the ore and the methods employed in its preparation. Owing to the rain a visit arranged to the smelting works on the following morning had to be abandoned.

On the return trip, the weather being more favorable, pictures were secured of the locks at the Sault and of the ore boats.

This region offers many very interesting features and it is to be regretted that the limited time at my disposal prevented me from making a more complete and satisfactory study.

Very respectfully submitted,

Carlos E. Cummings, M. D.,
Secretary.

Appendix D

Series of slides used in the Lectures.

SERIES	TOPIC	NUMBER
I	Jamaica, W. I. Tropical fruits, customs, geography, etc.	206
II	Bees and Insects	50
III	Birds and their homes	55
IV	Series on Indian Mounds	28
V	Winter Ice Fishing on Lake Erie	50
VI	Views on Great Lakes	31
VII	Nature Study	25
VIII	Darkest Africa (Studies at Pan. Am. Exposition)	67
IX	Buffalo and Vicinity	22
	Duplicates and miscellaneous	63
	TOTAL	597

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Notes on Jamaican Hemiptera

A Report on a Collection of Hemiptera made on the Island of Jamaica in the Spring of 1906

BY

E. P. Van Duzee

BUFFALO, NEW YORK
1907

EDWARD P. VAN DUZEE.

BULLETIN
of the
Buffalo Society of Natural Sciences

VOLUME VIII No. 5

Notes on Jamaican Hemiptera:

A REPORT ON A COLLECTION OF HEMIPTERA MADE ON THE ISLAND OF JAMAICA IN THE SPRING OF 1906

By E. P. Van Duzee
Buffalo, N. Y.

In the spring of 1906 it was my privilege to spend a few weeks collecting Hemiptera on the Island of Jamaica. I sailed from New York March 17th, arriving at Kingston on the morning of March 23d; returning I left Jamaica on April 19th. This gave me nearly four weeks on the island, but annoying rains on several days and three days of illness reduced somewhat my time available for field work. I was there at the close of the dry season when insect collecting was probably the poorest. The conditions there I found somewhat unfavorable when compared with those I was used to in the various portions of the United States where I have collected. The cost of living was high and the accomodations and food, except at Kingston, Mandeville and Port Antonio, were very poor. The heat also was a hinderance to my work, especially at Kingston, Balaclava and Montego Bay. At these warmer stations I generally had to be in out of the sun by nine o'clock, which was soon after the dew was off the vegetation, and could rarely start out again before three or four in the afternoon. In the short tropical days that left but little time for actual work in the field. At the higher altitude of Mandeville and on the northern side of the island the heat was less troublesome but there the rains would frequently begin by ten or eleven in the morning and practically put a stop to work for the day. Under these conditions I think the results of my work as given in the following

pages is on the whole satisfactory. The very large proportion of new species, more than one third of all those taken, shows how much need there is of thorough systematic collecting on this island, and the same is probably true of many of the other West Indian islands.

The localities and dates where most of my work was done are as follows:

Rock Fort, just east of Kingston. Here I collected along the shore road from the terminus of the trolley line for about three miles toward Morant Bay. The collecting was excellent after passing the old fort.

Kingston, March 26th. I left the trolley at a cross road about a mile south of the Constant Spring Hotel and worked toward the hills along the roadside and on adjacent fields. Collecting poor.

Kingston, March 27th. At Hope Gardens. Here I found good collecting along the lane leading from Papine to the Garden office and back of the office buildings.

Mandeville, March 29th to April 4th. I stopped at the Newleigh House and worked in the fields and on the hillsides in the neighborhood, where the collecting was the best I found on the island.

Balaclava, April 4th to 6th. Stopped at Malvern Hill and worked in the near-by fields and roadsides and along the railroad track for about a mile east of the town.

Montego Bay, April 7th and 8th. Here I worked along the shore toward the "Doctor's Cave", up a dry ravine behind the village, and along the road running up the hill to Paradise Pen. It was too dry and hot for good results here.

Appleton, April 9th. Collected east along the railway and on a cross road to the Shiloa River with good results.

Port Antonio, April 12th. Here the land was under complete cultivation and there were no good opportunities for collecting within walking distance of the Hotel.

St. Margaret's Bay, April 12th. Collected along the Rio Grande River just east of the village in the afternoon with satisfactory results.

Hope Bay, April 13th. Worked near the river and along the road east of the village. Collecting poor.

Richmond, April 14th and 15th. Worked on the Alexander estate and along the road north of the town and for about a

mile south of the railway station at Troja, the next station south of Richmond. The collecting was good at Richmond but poor at Troja.

Kingston, April 17th. In company with Mr. P. W. Jarvis I worked along the railroad track for about a mile west of the station and south to the shore with good results.

An examination of the species here listed will show a close parallelism with those recorded from the islands of Grenada and St. Vincent by Dr. Uhler. While each of these islands has its peculiar forms there are many species that seem to be common to all the larger islands and the coasts adjacent to the Caribbean Sea. Most of these widely distributed species spread northward only to Florida or at most along the Gulf coast to Texas and Mexico. A few however are found as far north as Canada. The material taken by me was too fragmentary a representation of the Hemipterous fauna of Jamaica to allow of any discussion of the geographical distribution of the genera and species or of a comparison of this fauna with that of the neighbouring islands or of the adjacent mainland.

I wish to express here my indebtedness to Dr. O. M. Reuter for his kindness in working up the difficult but interesting Capsids taken by me, and to Prof. E. D. Ball for his very valuable assistance in the verification and determination of the Homoptera.

In the following pages I have recorded *234* species as having been taken by me on this trip. Of these *85* species or varieties are new to science and among the latter are representatives of 9 new genera. An index to these new genera and species will be added at the end of the list.

Family Thyreocoridæ

Thyreocoris minutus Uhler.

Abundant at Mandeville on the hillsides back of the Newleigh House where I swept it from low weeds. I also took it at St. Margaret's Bay and in other parts of the island. Dr. Uhler described it from Cuban material and Prof. E. D. Ball has sent me specimens taken in Hayti. Aside from its small size it may be distinguished by its dull black color, closely punctured surface, transversely rugose pronotum and scutellum, prominent humeri and yellow elytra. The largest specimens I have seen

are rather smaller than the smallest *tibialis* and *pulicaria*. I have followed Dr. Oshanin in using this generic name in place of *Corimelæna*.

Thyreocoris cognatus n. sp.

Very near *pulicaria* from which it may best be distinguished by a comparative description. A little smaller and somewhat more elongated, punctures coarser and deeper over the whole surface. Head distinctly longer and more narrowed anteriorly. On the pronotun the callousities are more conspicuous as smooth slightly elevated surfaces and there is a slight trace of a longitudinal median line; the carinate lateral edge is continued around beneath the feebly elevated humeri, not conspicuously interrupted beneath the prominent gibbous humeri as in *pulicaria*. The antennæ are more slender and with the tibiæ and tarsi are paler; the pale margin of the corium is more distinctly punctate; the posterior margin of the scutellum is pale in all the specimens before me, and the margin of the connexivum posteriorly is marked with about three pale points in place of the pale line [sometimes broken] found in *pulicaria*. The genital segment of the male is a little longer and narrower with the sides more oblique than in *pulicaria*.

Described from numerous specimens taken at Rock Fort near Kingston. From *tibialis* this species differs in being proportionately longer and narrower, with a longer head and more closely punctured surface. The corium is pale with no indication of a black costal streak.

Thyreocoris basalis Germar.

Of this well marked species I took several examples at Balaclava, and found them not uncommon on weeds along the roadside at Richmond.

Family Scutelleridæ

Diolcus irroratus Fabr.

I took large numbers of this insect at Rock Fort on a coarse almost shrubby weed that has much the appearance of a Chenopodium, in the spiny angular bracts of which these insects were well concealed. I also took it near the Constant Spring Hotel, and at Mandeville and Montego Bay. In this species as in our northern *Eurygaster alternatus* the males were very uniformly punctured or obscurely mottled while the females were strongly marked. Prof. Ball has sent me a fine series of this insect taken on Hayti where it seems to be as abundant as in Jamaica.

Homœmus proteus Stal.

I took single examples of this species near the Constant Spring Hotel, at Balaclava, Montego Bay and Richmond.

Family Pentatomidæ

Mormidea pictiventris Stal.

Not uncommon at many places on the island. I took them at Mandeville, and in abundance at Balaclava. Most of these were deeply colored. Specimens in my collection from Columbia and Mexico are much paler.

Mormidea sordidula Stal.

I swept two examples of this from weeds along a roadside just north of Richmond on April 15th. In my collection is an example taken at Linares, Mexico by Prof. Gillette in July 1899. A similarly colored species from Trinidad, W. I., I have determined as *scutellata* Westw. It may be distinguished from the present by the pale venter and narrow pale calloused margins of the scutellum.

Oebalus pugnax Fabr.

One example swept from herbage by the roadside at Richmond.

Euschistus crenator Fabr.

Not uncommon in many places. I took it at Rock Fort near Kingston, Balaclava and Montego Bay. In each locality they were taken singly from bushes and coarse weeds.

In this species as I distinguish it the subacute humeri are directed slightly backward. In all my Jamaican and Mexican specimens the humeri are decidedly broader with their anterior margins convexly rounded. Those from the Island of Trinidad and Hayti have the humeri more acute and less recurved.

Euschistus bifibulus P. B.

This was a much more abundant species than the preceding all over the island but it was more common in the more humid and cooler localities while *crenator* affected the hotter and dryer parts of the island. In this species the humeri are produced in black acute horns which are directed distinctly forward. There is an obvious paler vitta connecting the humeri which is dislocated about an angular blackish mark on the median line, and the genital segment of the male is short with its apical margin broadly and deeply excavated. In *crenator* this segment is longer, narrowed posteriorly, with the apex feebly notched. I have received one specimen, apparently of

this species, from Mr. Underwood that was taken in Costa Rica. It differs from the Jamaican specimens in having the humeri more obtuse but still directed slightly forward, and the latero-anterior margins are more strongly denticulated.

Euschistus ursus n. sp.

Allied to *rugifer* Stal and pertaining to that section of the genus as arranged in the *Enumeratio*. Size and form of *bifibulus* nearly. Greyish testaceous; above coarsely punctured with black or dark brown, these punctures gathered into blackish areas on the pronotum and leaving a smooth bisinuated pale vitta between the humeri, produced at the middle in an abbreviated longitudinal vitta; base of the scutellum with three indefinite smooth pale spots. Elytra dotted with black, each dot covering from three to eight punctures. Antennæ and legs pale, the latter faintly dotted with brown. Beneath paler, obscurely maculated with a darker shade; median line and tip of the rostrum, a dot above the insertion of each leg, another on the anterior angle of the propleura behind the eye, and a spot at each incisure on the margin of the venter, black.

Head rather long, rounded before; cheeks and tylus of equal length, the latter quite regularly punctured with black. Antennæ unicolorous impunctate; first joint scarcely attaining the apex of the head, second distinctly shorter than the third. Humeral angles of the pronotum prominent, rounded before, subangular behind; latero-anterior margins quite strongly arcuated, blackened by the seggregated punctures, strongly crenulated with pale. Membrane obscured, impunctate, nervures irregularly bent but scarcely anastomosing. Connexivum closely punctured, the edge blackish with a round pale spot at the middle of each segment and an obscure line on the incisure. Rostrum attaining the posterior margin of the metasternum. Genital segment of the male rounded behind, feebly concave at apex. Length 10 mm.

Described from one pair taken at Rock Fort near Kingston and two males from Port au Prince, Hayti, received from Prof. Ball. This species has the size and form, nearly, of specimens of *biformis* Stal with rounded humeri, but in most of its characters it is much nearer to *rugifer* Stal. In the Haytian examples the dotting of the elytra is almost obsolete and the pale calloused vitta of the pronotum is sometimes inconspicuous. I have no doubt but this insect is the same as that figured by Palisot de Beauvois as the female of his *Pentatoma obscura* on plate 10, figure 9 and described on page 149 of his work. His male *obscura* however is the same as *crenator* Fabr. and I do not see how we can restrict the name *obscura* to the female of his species: I have therefore thought it best to rename the species.

Thyanta perditor Fabr.

Abundant everywhere on the island especially in the dryer localities about Kingston and at Mandeville and Balaclava. In my collection are specimens from Hayti, Mexico, Columbia and Peru. This species seems to be more constant in coloration than *custator*. All the examples before me have the pronotal band distinct, anterior to which are two round black points, and the edge of the abdomen is fulvous with a black point at each incisure. The base of the head between the ocelli and a median line on the tylus are rufous; there are generally a few brown points near the base of the membrane. The pronotal angles in all my specimens are acute and distinctly inclined forward.

Thyanta antiguensis Westw.

I swept five examples of this species from a low whitish succulent weed, apparently allied to *Chenopodium*, growing in masses along the roadside to Rock Fort. These agree in every particular with the material from Hayti described in my List of the Pentatomidæ of North America.

Loxa flavicollis Drury.

I took numbers of this large Pentatomid on the dry hot hillsides above the Rock Fort quaries. Most of these were beaten from Acacia bushes, March 25th. On April 17th I found the larvæ with the adults near Hope Gardens.

Loxa pallida n. sp.

Closely allied to *flavicollis* but smaller and narrower with the ground color a paler yellowish green, that may in part be due to immaturity. Transverse rugæ on the vertex and cheeks much less distinct, these surfaces much more strongly punctured with rufous; calloused outer margins of the cheeks before the eyes rectilinear or very feebly concavely arcuated, not distinctly bowed outward as in *flavicollis*, with their apex a little more slender and acute before the tylus. Surface of the pronotum, scutellum and elytra very uniformly and closely covered with rufous punctures arranged in anastomosing transverse lines, between which are a few pale calloused points. In *flavicollis* the punctured lines are farther apart with the intervening surface minutely shagreened and irregularly blotched with pale, as is also the apex of the scutellum and the disk of the corium. Humeral spines proportionately a little more slender than in *flavicollis*, and the abdomen narrower; the connexivum scarcely projecting beyond the elytra, pale, punctured with rufous inwardly as in that species. Lower surface a little more closely punctured with rufous; the apical spines on the outer genital plates of the female more abrupt and slender. Antennæ and legs pale with no indications

of dark punctures or markings except that the extreme tips of the tarsal claws are black. The second antennal joint is equal to the third, not distinctly longer as is generally the case in *flavicollis*. The rufous punctures form a tolerably distinct submarginal vitta about the head, pronotum and elytra as in the allied species. Length 19 mm.

Described from one female example taken with *flavicollis* at Rock Fort near Kingston. It is sufficiently distinct from that species as the above comparative description will indicate but it certainly is very close to *haematica* H. S. and may prove to be a pale form of that species. The difference in the color markings and habitat however seem to me to warrant its description as a distinct species.

Nezara viridula Linn.

I took a single example of this insect by the roadside near Hope Gardens at Kingston on April 17th. Later in the season it probably is not uncommon on this island as it is abundant on Hayti.

Nezara marginata P. B.

Abundant everywhere on bushes especially on the dry hot fields about Kingston. They fairly swarmed on weeds and low bushes along the river bank a little south of Hope Bay. In my collection are specimens from Peru, Bolivia, Venezuela, Costa Rica, Mexico, Hayti and the southern United States.

Piezodorus guildingi Westw.

I swept numbers of this insect from rank weeds along the roadside at Troja and Richmond, and also took them at Hope Gardens and near the Constant Spring Hotel at Kingston. All of my specimens have the base of the pronotum blackish bordered before by a pale calloused band. In none is the rufous band more than indicated. This band is beautifully developed in some examples kindly given me by Prof. E. B. Wilson which he took at Savannah, Ga.

Edessa meditabunda Fabr.

Swept from rank marsh plants growing along the railway tracks at Appleton. The larvæ were taken with the adults. This species seems to be widely distributed in tropical America. I have specimens from British Guiana, from the La Plata Country, and from Rio Grand de Sul and Victoria, Brazil. Distant places *rugulosa* Uhler as a synonym of this species in which I

believe he is correct, judging from a typical female from the island of St. Vincent kindly sent me by Dr. Uhler.

Edessa chelonia n. sp.

Allied to *meditabunda* but larger and more ovate and depressed in form. Deep grass green; clavus and inner field of the corium chestnut brown varied with pale punctures. Three lines of these punctures follow the claval suture, from the outermost of which a few transverse abbreviated lines of punctures radiate into the brown discal area; against the outer border of this brown area lies an indefinite cloud of the pale punctures. Membrane fuscous. Outer edge of the head and pronotum slenderly bordered with pale yellow. Tergum dark blue-green. Antennæ pale becoming a little dusky toward the apex; the basal two joints dotted with brown. Legs pale dotted with brown; the dots nearly obsolete on the posterior pair. Lower surface pale green; the minute hind angles of the abdominal segments and an annulus about the pale stigmata blackish-green. Rostrum pallid with the extreme tip black.

Head, pronotum, scutellum and outer field of the elytra closely and finely punctured between fine irregular rugæ; inner portion of the elytra more irregularly punctured. Apex of the scutellum a little wider and more obtuse than in *meditabunda*. Lower surface more coarsely and rugosely punctured, nearly smooth along the middle line; ventral spine broad and flat, obtusely angled at apex. Metasternal plate broad, lateral angles small and abrupt, posterior margin broadly excavated for the reception of the ventral spine. Disk of the genital segment of the male piceous black, its apical margin sinuated either side of the broad shallow median sinus, outer angles obtusely prominent. Length to tip of the membrane 14 mm.

Described from ten examples, representing both sexes, taken with numerous young from small trees growing in the fields along the railway a little west of the station at Kingston, April 17th. In Stal's synopsis in the Enumeratio this species would fall in the section with *meditabunda*, but the depressed and much broader and more ovate form and the finer and closer punctures will at once distinguish it; the brown on the elytra is also confined to the inner field and the venter wants the black incisures and stigmatal lines. I have been unable to identify this with any of the described species in this large genus known to me.

Family Coreidæ

Chariesterus gracilicornis Stal.

I captured one pair of this species while beating weeds along the railway track at Troja, April 14th, and three examples at Hope Gardens near Kingston. The latter have the plates on the third antennal joint a little wider than do those from Troja but I cannot see that they differ otherwise. In one

of the Trojan examples the third joint of the left antenna is wanting, the second joint is much longer and thicker than on the right side while the first and fourth joints are normal. Most of my specimens show a blackish vitta on either side before the ocelli, and in two females there are two broad black approximate longitudinal vittæ on the base of the pronotum. In all my specimens the incisures of the connexivum are faintly blackish.

Catorhintha guttula Fabr.

Not uncommon on low weeds at Rock Fort and Hope Gardens near Kingston the last of March and along the railway tracks west of the Kingston station on April 17th. Most of these specimens have the connexivum immaculate as in *selector* but in a few it is more or less maculated as is the case in specimens from Texas and Mexico in my collection.

Zicca tæniola Dallas.

Common. I have records of Mandeville, Balaclava, and Kingston where I found them in numbers on rank weeds about a brush pile at Hope Gardens. These average a little darker in color than a series I have from the island of Trinidad.

Chondrocera laticornis Lep.

This and the two following species were not taken by me but were kindly given me by my friend the late Albert Reinecke of Buffalo, an enthusiastic sportsman and student of birds, who visited Jamaica in 1903 and brought these back to me among other interesting insects and some land shells he gathered while on the island.

Sephina maculata Dallas.

Brought home from Jamaica by Mr. Albert Reinecke.

Anasa scorbutica Fabr.

Also taken by Mr. Reinecke in Jamaica with the preceding species.

Leptocorisa filiformis Fabr.

One example was taken at Hope Gardens near Kingston and another at Appleton on April 9th.

Magalotomus pallescens Stal.

Taken at Troja and Richmond. The males are pale and answer well to Stal's description except that the posterior

femora are infuscated, with a pale spot before their apex; the females are nearly black with the pale pectoral vitta almost obsolete; the venter is black with a few pale points on the sides, legs blackish with the tibiæ and base of the femora pale; the basal joint of the tarsi is ringed with pale and there is a pale spot on the front of the posterior femora near the apex. A good series in my collection from the island of Trinidad exhibit variations in both sexes from the darkest individuals to the pale form described by Stal.

Harmostes serratus Fabr.

This species was not uncommon on the island. I took it at Mandeville, St. Margaret's Bay, Troja, and Richmond. These specimens are larger and darker in coler than some sent me from the island of Trinidad by Mr. Chipman.

In my collection I find a single example from Brownsville, Texas, that differs from *serratus* in being smaller, paler in color, and in having the second joint of the antennæ equal to the third and the rostrum barely attaining the intermediate coxæ. These characters are just those given by Dallas to distinguish his *affinis* from *serratus* and I think it quite likely that it may be the form described by him.

Corizus pictipes Stal.

A very abundant insect everywhere I collected on the island. Mr. Chipman sent me large numbers from Trinidad showing it to be equally common there. I have also received it from Mexico and Florida.

Corizus hyalinus Fabr.

I took this with the larvæ at Hope Bay. It may be abundant later. It belongs to subgenus *Liorhyssus* Stal.

Jadera sanguinolenta Fabr.

One example taken in a house at Mandeville. I saw broken remnants in spider webs about houses in several places, so, apparently, the season for its occurrence had about passed. Mr. Reinecke took it in Jamaica in February and I have specimens taken in British Guiana by Mr. Crew.

Family Metacanthidæ

Jalysus reversus n. sp.

Close allied to *macer* Stal. Pale ochraceous. Head with the basal collum and three longitudinal lines pale; the lateral interrupted by the

antenniferous tubercles; the intermediate a little expanded between the antennæ and on the tylus; tip of the labrum black, polished; pale basal collum interrupted by the large red ocelli below which is a pale spot followed by a fuscous one behind the eyes; lower surface paler with an abbreviated rufescent vitta either side of the middle. Basal joint of the antennæ nearly or quite as long as the two succeeding together, strongly annulated with black, second a little shorter than the third, both of these joints dusky; fourth about two thirds the length of the second, black with the apical one third white and the extreme tip blackish; all the incisures pale. Pronotun closely and regularly granulated; anterior lobe clearly defined, sublunately convex posteriorly, anterior angles rounded, prominent; these and a median basal spot obscurely pale and calloused; posterior lobe gibbous, with a feeble pale median carina which becomes obsolete behind the middle, the posterior margin narrowly reflexed and pale, a little emarginate at the middle; anterior angles tuberculate, pale and calloused. Sternum darker rufous, mesosternum with two pale feeble median carinæ, divergent posteriorly; osteolar spine long, straight, rather stout and pale at base with a more slender black tip. Scutellum rather narrow, armed on the base with a long curved pale spine. Hemelytra almost attaining the apex of the abomen, greenish hyaline, costal nervure slenderly blackish, the other nervures and the clavus ochraceous, the latter transversely wrinkled. slender apex of the corium linear, defined within by a blackish nervure, reaching three fourths the length of the membrane. Membrane transversely wrinkled with about four simple straight nervures. Abdomen greenish above, at least on the connexivum, more ochraceous beneath and on the base of the tergum. Legs long and slender dotted and annulated with black, apex of the tibiæ and tarsi blackish. Length 6½ mm.

Described from 14 specimens taken as follows: Rock Fort, near Kingston; Balaclava; Montego Bay; Kingston, from the railway yards just west of the city, April 14th. It was a common insect everywhere on the island.

This form is closely allied to *macer* and *tenellus* Stal but the fourth antennal joint is white on the apical one third with the tip black, not black with the extreme tip white; the elytral nervures are ochraceous not testaceous white, and there are other points in which it fails to answer to Stal's descriptions. The apex of the first joint of the antennæ and the femora are clavate, brownish, tipped with pale. The greenish color of the abdomen and elytra may be dependant upon an immature condition, as some individuals are entirely ochraceous tinged with rufous in places, especially on the tergum.

Metacanthus decorus Uhler.

Taken at Mandeville and Balaclava. Apparently more characteristic of the higher elevations. In his Rhynchotal Notes, no. 10, Dr. Distant places this species as strictly con-

specific with *Metacanthus capitatus* of Uhler and there certainly is nothing in the descriptions to distinguish the two species. Dr. Uhler's new genus *Protacanthus*, established for *decorus*, seems to differ from *Metacanthus elegans* only in having the rostrum a little longer and the spines at the anterior angles of the pronotum longer and more slender.

Family Lygaeidæ

Oncopeltus pictus n. sp.

Closely allied to *varicolor*. Orange fulvous marked with black and white. Head fulvous, apex of the tylus base of the vertex, occipital area, and antenniferous tubercles black; Antennæ black, proportionately shorter and thicker than in *varicolor*, second joint perhaps a little longer relatively. Rostrum black, shorter than in its ally, scarcely attaining the apex of the first ventral segment. Pronotum narrower than in *varicolor* with the lateral margins rectilinear, not arcuated; humeral angles not rounded; depressed basal margins narrow and broadly rounded, not broad and subangularly produced as in *varicolor;* color fulvous, base, sides, and median line black. Scutellum black. Elytra black with a large white spot on the base and another at apex, omitting the costal nervure, the apical spot obliquely produced and arcuated anteriorly; not cut square across as in *varicolor*. Beneath fulvous; meso- and meta-sternum, except their posterior margins, a cloud exterior to the coxæ, much smaller on the propleura, edge and apex of the venter and a discal area, which scarcely attains the base and extends to the margins on the fifth and sixth segments, black. Tergum apparently coccineous with the apex, narrow lateral margins, and a transverse vitta on the posterior segment, black. Legs black. Length: male, 10; female 12 mm.

Described from a single pair taken on the northern side of the island; the male at St. Margaret's Bay; the female at Hope Bay.

This species may vary in color as does its ally but the different form of the pronotum, as well as the shorter antennæ and rostrum will distinguish the species. It is also smaller and has the elytra proportionately narrower at base. My specimens of *varicolor* are from the island of Trinidad and agree very closely with Distant's figure in the Biologia.

Oncopeltus gutta H. S.

One male swept from weeds by the railway tracks near the Kingston station, April 17th. This corresponds with Distant's Biologia figure except that the ground color is a light scarlet including the entire head except the apex of the tylus and a cloud behind the ocelli, and the sides of the scutellum.

Oncopeltus sandarachatus Say.

Abundant everywhere I collected on the island. Those from the hilly districts about Mandeville, Balaclava, and Appleton were of the pale form as described by Say and were smaller. Those from the north side about Hope Bay and St. Margaret's Bay were more deeply colored and were larger. I can however find no specific characters to distinguish these two forms and all gradations occur connecting the two.

Lygaeus (Graptolomus) formosus Blanch.

I captured four examples of this pretty species at Rock Fort, and have in my collection another labelled Port au Prince, Hayti, that was received from Prof. E. D. Ball. Heretofore this species has been recorded only from the continental countries from Mexico to Venezuela.

Lygaeus (Ochrostomus) pulchellus Fabr.

Taken at Constant Spring near Kingston, in an old banana field overgrown with weeds; Montego Bay, April 8th, with the young; Richmond, April 15th with larvæ. Prof. E. D. Ball has sent me specimens from Port au Prince, Hayti.

Ortholomus jamaicensis Dallas.

I took occasional examples of this species at various places on the island and found it fairly abundant at Richmond. These specimens agree in every respect with Dallas' short but adequate description. I have compared them very carefully with Uhler's description of his *providus* and am compelled to the conclusion that our well known Hemipterist has combined the characters of this species and the common *longiceps* Stal from the United States in forming his *providus*. It is not unlikely however that these really may be forms of one and the same species in which case Dallas' earlier but awkward name will take precedence over those of Stal and Uhler. Dr. Distant has already pointed out the identity of Uhler's species with that of Dallas. I feel inclined at present to follow Baker in placing *Ortholomus* as a genus distinct from *Nysius*.

Ninus notabilis Dist.

One example swept from weeds at Mandeville.

Ischnorrhynchus championi Dist.

This tiny insect was common almost everywhere on the island. I took it most abundantly about Kingston and at Mandeville.

Blissus leucopterus Say.

I watched closely for this insect but found only two examples, both brachypterous. One I took in the railway yards at Kingston, April 17th, and the other in an old banana plantation about a mile south of Constant Spring Hotel. Both are small and proportionately more elongated than specimens from the northern states. It is of course quite possible that they may have been introduced from the United States as they were taken near the principal seaport of the island.

Ninyas Strabo Dist.

This looks like a miniature *Geocoris*. I found it not uncommon toward the western end of the island. It was taken at Mandeville, Balaclava, Appleton and Montego Bay.

Paronius longulus Dallas.

I took a few examples of this widely distributed species at Hope Gardens at Kingston, under a pile of brush and rubbish. I also took it on cultivated lands at Mandeville.

Pamera vincta Say.

Common everywhere I collected in the southern and western districts of the island. Distant now places as synonyms of this species *parvulus* and *gutta* of Dallas, *amyoti* of Guerin, *vinulus* of Stal, and *bipunctatus* of Kirby; thus extending its range to India and Ceylon.

Pamera bilobata Say.

I found this species fairly common at Rock Fort near Kingston, Mandeville, Hope Bay, Troja and Richmond. These specimens were a little smaller and more clearly marked than those I have seen from the United States. They very closely resemble Distant's figure of *Pamera vicinalis* on plate 19, fig. 13 of the Biologia.

Pamera sp.

Mandeville, April 1st, one example. This specimen is somewhat mutilated and I have been unable to place it satisfactorily. It has a broad form and shows some affinities with genus *Ptochiomera* but the clavus is irregularly punctured and I prefer to place it in *Pamera*.

Ptochiomera sp.

St. Margaret's Bay, April 12th, one example. This is a tiny little insect scarcely more than a millimetre in length. It might be mistaken for a *Cligenes* were it not that the sides

of the pronotum are not at all carinate. In form it much resembles *Ptochiomera nodosa* but is not half its size and has the apical joint only of the antennæ moderately enlarged.

Ozophora pallescenes Dist.

One example, taken at Hope Bay April 12th, agrees exactly with Distant's figure and description. I have received it also from the island of Trinidad.

Ozophora concava Dist.

I took one example of this species at Gordon Town, March 24th. It would not be surprising should a long series show this and *pallescens* to be forms of a single variable species.

Family Pyrrhocoridæ

Dysdercus mimus Say.

Very abundant at every locality where I collected on the island. I took all variations in size, form and marking as described by Dr. Uhler in his List of the Hemiptera from West of the Mississippi River.

Dysdercus andræ Linn.

Another very common species occurring in great numbers on certain trees and bushes, and frequently coming to light at night. I have this species from Cuba and Mrs. Annie Trumbull Slosson has taken it in Florida.

Dysdercus jamaicensis Walker.

I took this large showy species from the hillside at Port Antonio and at St. Margaret's Bay, Richmond, and at Hope Gardens at Kingston. At Balaclava I took it on a large tree called by the natives "Aaron's Rod." The six individuals taken by me show but slight variation in the extent of the black markings. They differ from Walker's description only in having the rostrum extended to the middle of the third ventral segment. *D. sanguinarius* Stal is an allied species with a longer rostrum and black scutellum.

Family Tingidæ

Corythuca gossypi Fabr.

Many examples of this tiny species were taken at Kingston, Mandeville and Montego Bay. It may readily be distinguished from *spinosa* Champ., which it most closely resembles, by its

having the median pronotal carina nearly or quite as high as the hood, which is set well forward.

Corythuca marmorata Uhler ?

I beat numbers of this species from a bush on the bank of a ravine back of Montego Bay. I do not yet feel fully satisfied of its identity with *marmorata*.

Corythaica carinata Uhler.

I took two examples of this queer looking insect by the railroad tracks east of Balaclava on April 5th; several at Kingston, and found it common at Montego Bay on bushes along the roadside near Paradise Pen. Two of those from Kingston are smaller and paler and seem to be somewhat immature. Dr. Uhler described this species from material taken on the island of Grenada.

Leptostyla tumida Champ.

This is one of the most beautiful Tingids that has come under my observation. I swept eight examples from low weeds about a mile east of Rock Fort, Kingston, on March 25th. My specimens correspond in every respect with Champion's figure and description.

Leptostyla angustata Champ.

A pretty little whitish species of which I took five examples at Montego Bay. These differ from the description in the Biologia in having a round blackish spot a little behind the middle of the discoidal area, which is almost obsolete in some individuals and very distinct in others.

Leptostyla constricta Champ.

One specimen of this little species was swept from grass and weeds along the railroad track a little south of the station at Troja. The apical joint of the antennæ is dark brown rather than black.

Leptostyla colubra n. sp.

Form and general appearance of *constricta* Champ. Body black; spines of the head, antennæ, bucculæ, and legs pale testaceous or white. Basal joint of the antennæ about twice the length of the second; third elongated, slender; fourth about equal to the first and second united, darker. Pronotum broad across the subangulated humeri behind which is a distinct transverse impressed line separating the large triangular posterior portion, the extreme tip of which is truncated and slightly emarginate. Anteriorly the

pronotum is strongly narrowed; sides with a slender carina which is higher across the anterior sinus; hood moderately elevated; disk strongly, almost tubercularly elevated, as high as the hood, tricarinate; color ferruginous becoming blackish posteriorly; the median carina and a slender line bounding the pale lateral carinæ, black; hood and anterior edge of the pronotum white, the latter with two black points beneath the hood. Elytra fuscous or blackish, the costal area whitish hyaline, broken by a broad black band at the middle and a narrower one at apex, the disk of some of the apical areoles subhyaline; bounding nervures of the discal area white at apex; discal, subcostal and sutural areas finely areolate, the costal and apical areoles larger; costal area indistinctly triseriate. Wings almost attaining the apex of the elytra. Rostrum reaching the insertion of the posterior legs. Length 2 to 2½ mm.

Described from 22 examples taken at Mandeville and Balaclava where it appeared to be common. This little species has the form, size and markings almost exactly of *constricta* but may readily be separated by its having the expanded membranous margins of the pronotum reduced to a mere carina; the disk much more convex and divided by a transverse suture, and the posterior tip truncated. The basal joint of the antennæ is also a little shorter and the colors are more varied. Some of these characters might be construed to be of generic value. The specific name is suggested by the dark markings which recall those seen on certain serpents.

Acanthochila armigera Stal.

I took four adults and one larva of this pretty species from the hill south of the Newleigh House at Mandeville, and two adults by the roadside near Paradise Pen at Montego Bay. These are all rather pale ferruginous with the head, apical joint of the antennæ, its base excepted, anterior disk of the pronotum, body beneath and tips of the marginal spines of the pronotum, black. The two long spines on the head are white and conspicuous, and the transverse vitta on the elytra is pale and poorly defined.

Acanthochila spinicosta n. sp.

Closely allied to *armigera* but differing principally in having the costa armed with spines to behind the middle, those near the base longer, and tipped with black as are those of the pronotum; the head ferruginous instead of black; the basal joint of the antennæ with a black line exteriorly, and the apical joint black only on its apical one third. Membranous margin of the pronotum somewhat broader than in *armigera;* disk of the discoidal and subcostal areas conjointly ferruginous, darker than in *armigera*, the intervening carina white at apex with a black dash before the middle.

Lower surface of the head pale, of the body deep black, with the insertions of the coxæ, broad margins of the propleura, legs and rostrum pale. Genital segment ferruginous. Bucculæ white. In *armigera* as known to me the entire lower surface is deep black with the bucculæ white and the rostrum, legs and insertion of the coxæ pale. The spines on the base of the vertex are whitish as in *armigera* but the transverse black band on the anterior lobe of the pronotum of that species becomes paler in this.

Described from one example taken on the borders of a rich cultivated field at Mandeville, April 3d. This species has the form and general appearance of *armigera* but the characters given above will readily separate it. I confess that I do not feel at all certain of the synonomy given by Mr. Champion in the Biologia for *armigera* Stal.

Amblystira maculata n. sp.

Closely allied to *opaca* Champ. Deep black, shining; antennæ, legs and elytra whitish, the latter with a large angulated median black spot, which omits the calloused sutural and apical margins and becomes much narrowed to the costal nervure, along which it runs anteriorly for a short space; the large sutural area is a little enfumed, with black nervures. Antennæ: first and second joints short, subequal in length; third about twice the length of the fourth; apical one third of the latter blackish. Bucculæ narrowly edged with pale. Pronotum obscurely carinate on the sides; disk tricarinate, median carina strong, scarcely attaining the apex of the posterior prolongation, the lateral subobsolete; whole surface coarsely punctate. Elytra with the discoidal area narrow, subcostal finely reticulated in several rows; costal area forming a very narrow margin to the subcostal, beyond that much widened, with one series of large areolæ. Wings smoky toward their tips, with fuscous nervures.

Described from one example taken on the hillside south of Richmond village, April 15th. Differs from *opaca* in color, the shining black of the upper surface, the tricarinate disk of the pronotum, and the large areolæ in the sutural area of the elytra.

Leptoypha binotata Champ.?

Kingston, two examples swept from bushes near the railroad tracks west of the station on April 17th. I feel some uncertainty about this determination as these specimens differ from Champion's description in several particulars. The body is dark ferruginous, not black, beneath; the elytra have a double transverse vitta and the whole sutural area fuscous, with the included nervures black; the discoidal and subcostal areas are confused, and together with most of the sutural area are closely and minutely areolate; costal area very narrow and uniseriate; wings well developed. I have little doubt but

further West Indian material would connect these with the darker specimens from the main-land described by Mr. Champion.

Teleonemia sacchari Fabr.

Taken in numbers at almost all places where I collected on the island.

Teleonemia scrupulosa Stal.

Taken with the preceding and equally abundant. I distinguish this species most readily by its smaller size, paler color, the longer pale spines on the head, and particularly by the much wider costal area.

Teleonemia prolixa Stal.

Troja, April 14th, one example. Mr. Otto Heidemann who has determined this species for me and who has very kindly assisted me in the verification of some of the doubtful species of the Tingids thinks this the "*var. a*" of *prolixa* as described by Mr. Champion. This is a larger and darker species than *sacchari*, with a narrower and more sinuated costal margin. I have in my collection a still larger and darker specimen taken by Mr. R. J. Crew near Demerara, British Guiana, April 12th, 1901.

Teleonemia cylindricornis Champ.

This is a larger and paler species of which I took two specimens at Mandeville and one at Hope Gardens, near Kingston, among weeds by a roadside on March 27th. This species is separable from the two preceding by its larger size, longer and stouter antennæ, and by the partially biseriate costal area. It is very close to *variegata* Champ. of which Mr. Otto Heidemann has very kindly sent me an example taken in Arizona. I can separate *cylindricornis* by its having the median pronotal carina distinctly elevated in front and the lateral carinæ almost parallel behind, not distinctly divergent as in *variegata*; and the costal area is much more distinctly biseriate. The antennæ are longer and stouter and the elytra more ampliated, but these characters are less noticeable.

Atheas nigricornis Champ.

Several examples of this species were swept from herbage in a pasture at Mandeville, March 30th. These have the extreme

tip of the third antennal joint paler and the apex of the discal area of the elytra blackish. In all other respects they agree with Champion's description and figure.

Monanthia monotropidia Stal.

Three examples swept from weeds along the road to Paradise Pen at Montego Bay, April 8th.

Monanthia c-nigrum Champ.

Mandeville, three examples: a large specimen taken on the hillside near the Newleigh House, March 29th, and two smaller ones from a cultivated field April 3d. These all agree well with Champion's figure and description except that the femora are concolorous, ferruginous, instead of black.

Family Phymatidæ

Phymata marginata Fabr.?

I took one example of this little species from bushes along the roadside in Balaclava village on April 6th. This is a male measuring but five millimetres in length, and differs from the figure and description given by Handlirsch in having the posterior "wings" of the pronotum and the expansion of the connexivum on the fourth abdominal segment less pronounced and acute. They seem to agree in all other essential respects and I see no reason to doubt the correctness of this determination.

Family Veliidæ

Rhagovelia Taylorella Kirk.

I found quite a colony of these active little insects sporting on the surface of a small stream near the railroad station at Troja. In all of these the legs are metallic greenish black, with the trochanters, coxæ, base of the anterior femora and of the other femora beneath, fulvous.

Microvelia pulchella Westw.

One fully winged example that I determine as Westwood's species was taken from a rivulet near the road about a mile south of the Constant Spring Hotel. The elytra in this are really dull whitish with the nervures broadly fuscous; the pornotal collum is fulvous, bisected by the blackish median pronotal line. This individual answers in all respects to the brief description given by Amyot and Serville except that the elytra

are more obscurely white. Dr. Uhler's *M. robusta* would seem to be a very closely allied species.

Near Rock Fort I took from a little pond of water by the roadside a larval form of *Microvelia* that I take to be the young of the present species as it has the same characters of the antennæ and legs. It is blackish above with the collum and a large quadrate spot on the middle of the pronotum and a dot on the connexival margin of the first tergal segment fulvous.

I was much disappointed in not taking more of the aquatic and littoral forms of the Hemiptera in Jamaica. Although I searched diligently wherever I collected near the water I took but this, the *Rhagovelia* mentioned above, and the single specimen of *Buenoa* noticed further on.

Some years ago while collecting at Rivington, N. J. with Prof. C. W. Johnson my attention was directed by him to a colony of *Microvelias* that had their home in a water barrel under some trees. These specimens agree in every respect with Champion's description of his *albonotata*, founded on a single specimen from Guatamala. This differs from Uhler's description of *modesta* in several minor particulars, and for the present at least I prefer to place these northern specimens under Champion's species.

Family Reduviidæ

Ghilianella Signoreti Dohrn.

This large species was not uncommon on trees and bushes in various parts of the island. I have notes of having taken it at Mandeville and Hope Bay. In the specimens brought home the intermediate and posterior legs are no darker than the anterior but show the pale rings on the femora quite distinctly. Two small immature examples from Mandeville and Balaclava are apparently the young of this species.

Ploiariola errabunda Say.

I captured three specimens at Mandeville that I cannot distinguish from this species as found in the United States.

Luteva sp.

One example of a species I have been unable to determine was taken at Balaclava, April 5th.

Pnirontis infirma Stal.

One nymph that I place here was taken at Mandeville, April 1st. The extreme edge of the abdomen has not the black spots mentioned by Stal but that character may depend somewhat upon maturity.

Zelus rubidus St. F.

This was a common insect throughout the island. I took it wherever I collected. I can see no reason for separating this from *Zelus longipes* Linn. Our northern form, *Zelus bilobus* Say, is reasonably distinct in having a longer and more slender head.

Metatropiphorus Belfragei Reut.

One slightly immature example of this interesting insect was swept from grass and weeds at Hope Gardens, Kingston, March 26th. In this individual the elytra are somewhat flaccid, pale, with the nervures fuscous on their base and across the middle, thus indicating the dark bands mentioned by Reuter. In all other characters it agrees exactly with his description.

Nabis sordidus Reut.

A macropterus example was taken near the Constant Spring Hotel and a brachypterous one from the roadside a little beyond Rock Fort.

Nabis ferus Linn.

Two examples from the fields near the Constant Spring Hotel, March 26th. These are a little longer and narrower than examples from further north but I cannot distinguish them specifically.

Carthasis rufonotatus Champ.

I took several examples of this delicate little species at Mandeville and Balaclava. These were beaten singly from trees in open sunny situations.

Family Cimicidæ

Cimex lectularius Linn.

Not an uncommon guest at the hotels in the smaller towns and interior villages.

Family Anthocoridæ

Piezostethus sp.

Numbers of a small species in this genus that I have been unable satisfactorily to determine were taken in various parts of the island.

Triphleps insidiosus Say.

One specimen, certainly pertaining to this species, was taken at Mandeville and two smaller examples that I cannot feel sure are distinct were swept from herbage at Hope Bay.

Cardiastethus fraterculus n. sp.

Fulvous, tinged with rufous in places. Head and prothorax rufo-piceous; the pronotum, excepting the disk of the anterior lobe, and the humeri piceous black with metallic reflections in certain lights. Elytra dull and opake, apical one half of the clavus, disk of the corium, and inner field of the embolium within the longitudinal furrow, fuscous; cuneus blackish. Membrane fuscous with iridescent reflections, the inner margins fulvous at base and pallid toward the apex. Antennæ, rostrum and legs testaceous yellow.

Head short, the prolongation before the base of the antennæ quadrate. Eyes large, granulated. Antennæ: first joint attaining the apex of the head, second longest, clavate and fuscous at apex, third and fourth more slender, dusky, fourth shortest, much shorter than the third; all but the basal armed with long scattering hairs. Rostrum reaching to between the anterior coxæ. Pronotum broad, transverse, strongly narrowed to the front, sides feebly arcuated; surface coarsely punctured, omitting however the large pale disk of the anterior lobe; collum rather narrow, distinct. Scutellum pale, the transverse impression conspicuous. Elytra with scattering coarse shallow punctures; embolium narrow, at apex about one half the width of the corium; nervures of the membrane almost obsolete. Propleura and sutures of the other pleural pieces rufo-piceous. Osteolar canal long, strongly curved and attaining the anterior suture of the mesopleura. Whole upper surface sprinkled with short, stiff, yellow hairs. Length 2 mm.

Described from one example taken at Mandeville, March 29th. This seems to be quite distinct from any species yet described. It answers most nearly to Reuter's description of *Pergandei* but has the short rostrum and feebly sinuated costa, and in his synopsis would go directly to *consors* from New Zealand. It is perhaps still nearer to *assimilis* which has a short rostrum notwithstanding that Prof. Reuter has placed it in his table among those in which the rostrum attains the middle of the mesosternum. From that species however ours may be distinguished by the different sculpture of the pronotum, the

deeper impression on the disk of the scutellum, the narrower embolium, and the different coloring.

Termatophylidea pilosa Reut.

Quite a number of specimens of this very interesting species were beaten from bushes and small trees at Mandeville, Balaclava and Montego Bay. Dr. Reuter writes me that this is the first American representative he has seen of this subfamily of the *Anthocoridæ*. He will describe the genus and species, both of which are new, in a paper on the *Termatophylinen* he now has in preparation.

Family Capsidæ

The Capsidæ were well represented among the material taken in Jamaica. The specimens averaged much smaller than those found in the United States and in most cases but few individuals of each species were taken, but this was true of all the Hemiptera I took on the island. Some of these Capsids were very prettily colored and marked and the collection on the whole was an interesting one. Dr. O. M. Reuter of Helsingfors very kindly offered to study these for me and has published the results of this study in the Of. Finsk Vet-Soc. Forhandl. xlix. No. 5, pp. 1 to 27, 1907, to the pages of which paper reference is made after the name of each new genus and species. In this paper Dr. Reuter has described as new seven genera, twenty nine species and two varieties from the material brought home by me. In the nomenclature and arrangement of the divisions, and so far as possible of the genera, I have followed the classification published by Dr. Reuter in the Festschrift für Palmen No. 1, p. 27 et seq., 1905.

Division Plagiognatharia

Psallus atomophorus Reut. (n. sp. p. 22.)

Two examples taken at Rock Fort near Kingston, March 25th. This is a delicate little species of a pale yellow color with a fuscous cloud across the elytra and the whole upper surface dotted with brown points.

Psallus (?) sulphureus Reut. (n. sp., p. 23.)

Taken in numbers along the roadside at Rock Fort. It is a pale yellow species with a black point on the apex of the cuneus and a dot a little behind this on the margin of the maculated membrane.

Reuteroscopus ornatus Reut.

One example of this northern species was taken at Hope Gardens and another near Constant Spring Hotel at Kingston. The generic name *Episcopus*, under which this species was described, being preöccupied Mr. Kirkaldy in 1905 proposed the name *Reuteroscopus*, (vide Reuter) and again in 1906 the name *Aristoreuteria*, the former of which has been adopted by Dr. Reuter.

Atomoscelis diaphanus Reut. (n. sp., p. 24.)

Mandeville, April 2d, one example.

Leucopoecila (Reut. n. gen., p. 24) **albofasciata** Reut. (n. sp., p. 26.)

Rock Fort, March 25th, two examples. This is a little black insect resembling our northern *Chlamydatus* (*Agalliastes*) but marked with a transverse white band on the elytra.

Sthenarus plebejus Reut. (n. sp., p. 26.)

Mandeville, seven examples Balaclava, one example. A shining black little creature with the base of the antennæ and legs pale yellow.

Sthenarus basalis Reut. (n. sp., p. 26.) Mandeville.

Division Cyllocoraria

Jornandes semirasus Dist.

Very abundant at Mandeville and Balaclava and also taken at Richmond. This species looks somewhat like a miniature *Ceratocapsus* (*Melinna*) *modesta* Uhler. Distant's material was from Guatemala.

Zanchisme illustris Reut. (n. sp., p. 11.)

Balaclava, April 5th, two examples. A neat little species with much the aspect of a small *Pilophorus*. This generie name was substituted for Reuter's preöccupied name *Schizonotus* by Mr. Kirkaldy in 1904.

Falconia caduca Dist. var. (Reut. p. 11.)

Mandeville and Balaclava. A pale yellow species with nearly the form of a *Dicyphus*, with the eyes and apex of the scutellum deep black, and the last joint of the antennæ, claval suture and a spot on the base of the membrane fuscous. The type was from Guatemala.

Baculodema (Reut. n. gen., p. 12.) **luridum** Reut. (n. sp., p. 13.)

Balaclava, one example. Looks like a slender *Jornandes.*

Ceratocapsus nigro-piceus Reut. (n. sp., p. 13.)

Balaclava, four examples; Montego Bay, one example. Dr. Uhler described this genus in 1887 as *Melinna* and Mr. Kirkaldy renamed it *Hypereides* in 1903. Dr. Reuter however considers it identical with his genus *Ceratocapsus* published in 1875.

Ceratocapsus consimilis Reut. (n. sp., p. 14.)

Balaclava, one example. This has much the appearance of a small *Ceratocapsus modestus* Uhler.

Orthotylus compsus Reut. (n. sp., p. 14.)

Kingston, one example.

Orthotylus divergens Reut. (n. sp., p. 15.)

Rock Fort, near Kingston, two examples. A pale little species with a red band across the base of the elytra and scutellum and a black membrane.

Platyscytus (Reut., n. gen., p. 16.) **binotatus** Reut (n. sp., p. 17.)

Hope Gardens, Kingston, one example. This is an odd little insect: pale yellow with the scutellum and a round dot on each elytron red.

Melanostictus (Reut., n. gen., p. 17.) **Van Duzeei** Reut. (n. sp., p. 18.)

Balaclava, April 5th, one example.

Hyalochloria (Reut., n. gen., p. 18.) **caviceps** Reut. (n. sp., p. 20.)

Not uncommon. I took it at Mandeville, Balaclava, Montego Bay and Richmond. This is an exceedingly delicate little insect much resembling *Diaphnidia parvula* Uhler from Florida.

Hyalochloria unicolor Reut. (n. sp., p. 20.)

Mandeville, March 31st., one example.

Mesotropis (Reut. n. gen., p. 21.) **viridifasciatus** Reut. (n. sp., p. 22.)

Hope Gardens and Constant Spring Hotel, Kingston, two examples; Balaclava, one example. Another delicate green little species with a band of deeper green across the elytra, which may, however, be almost obsolete.

Division Pilophoraria

Tiryus punctulatus Reut.

Taken at Mandeville, Balaclava, Montego Bay and Richmond. Described in 1875 as a *Trichia* from material taken in the southern United States.

Division Dicypharia

Dicyphus separatus Uhler.

I took numbers of this species from a bush, I think a species of Croton, growing in a garden at Gordon Town, March 24th, and at Rock Fort the next day. Dr. Reuter did not report on this species but my specimens seem identical specifically with others in my collection from Maryland and Florida, and my friend W. J. Palmer took what I believe to be the same species at Lake Temagami, Ontario, (See Can. Ent. xxxviii, p. 407, 1906.) In my report upon these Temagami Hemiptera I listed this species as a *Macrolophus* under which name I had received it from correspondents. I now find that it was described as a *Dicyphus* by Dr. Uhler (Proc. Zool. Soc., 1893, p. 194), from specimens taken in the island of Granada together with material from the United States.

Division Laboparia

Halticus Uhleri Girard.

Common at Mandeville and Balaclava. Dr. Distant has redescribed this species in the Biologia as *Calocoris canus*.

Division Miraria

Collaria oleosa Dist.

A very abundant insect everywhere on the island.

Trigonotylus tenuis Reut.

A delicate little species of which I took four examples at Hope Gardens at Kingston, April 17th.

Creontiades rubrinervis Stal.

This was the largest Capsid taken by me on the island. I found it at Mandeville, Balaclava and Appleton The type specimens were from Mexico. Distant records it from Guatemala and Uhler from St. Vincent and Granada, and Mrs. Slosson has

taken it at Biscayne Bay, Florida. I follow Reuter in placing this genus in the *Miraria*.

Division Capsaria

Phytocoris compsocerus Reut. (n. sp., p. 4.)

I took two examples of this at Mandeville and two at Balaclava. It is closely allied to *eximus*.

Lygus apicalis Fieb.

Three examples taken near the Constant Spring Hotel. This is a small green species somewhat resembling *prasinus*. It was described by Fieber in his Europäischen Hemiptera from material taken in Spain. I cannot find any previous record of its having been taken in America.

Lygus apicalis var. **inops** Horv.

Very near the preceding. I found this form at Hope Gardens and in numbers at Mandeville.

Lygus aeruginosus Reut. (n. sp., p. 5.)

Mandeville, April 1st, two examples. A shiny little species with much the aspect of an *Orthops*.

Lygus olivaceus Reut. (n. sp., p. 6.)

Not uncommon on the southern side of the island. I took it near the Constant Spring Hotel, at Mandeville, Balaclava and Montego Bay. It looks somewhat like a small compact *invitus*.

Lygus suspectus Reut. (n. sp., p. 6.)

Smaller and more strongly maculated than the preceding. I took one example at Rock Fort, March 25th, and another at Mandeville, April 3d.

Lygus cunealis Reut. (n. sp., p. 7.)

Mandeville, three examples. At Balaclava I took two examples of what seems to be a pale form of this species. *Cunealis* is near the preceding species but has the pronotum behind, scutellum, clavus and inner angle of the corium piceous black.

Pœciloscytus cuneatus Dist.

Common about Mandeville and Balaclava. I also took it at Rock Fort near Kingston. I have received this species from British Guiana and the island of Trinidad and Distant, who

described it as a *Lygus*, records it from Mexico and Central America.

Pœciloscytus cuneatus var. **rufu-cuneatus** Reut. (n. var., p. 8.)

Differs from the typical form in being paler with a red cuneus. I found it abundant, particularly about Mandeville.

Pœciloscytus flavo-cuneatus Reut. (n. sp., p. 8.)

Two examples taken at Hope Gardens, March 26th. Very near *cuneatus* of which Dr. Reuter thinks it may prove to be a variety.

Cyrtocapsidea irrorata Reut. (n. sp., p. 9.)

Mandeville, April 1st, one specimen. This is a pretty little species with somewhat the aspect of a small *Phytocoris*. Dr. Reuter records its occurrence in Mexico.

Neoborops oculatus Reut. (n. sp., p. 10.)

Mandeville, April 1st, one example.

Division Clivinemaria

Lamproscytus (n. gen. Reut., p. 3.) **Van Duzeei** Reut. (n. sp., p. 4.)

Mandeville, one example. Looks a little like a small *Pilophorus*. Piceous black with red elytra marked with a large white spot on the membrane.

Division Bryocoraria

Cyrtocapsus caligineus Stal.

Taken at Kingston, Mandeville, Balaclava and St. Margaret's Bay. Not uncommon. Distant records it from California, Mexico and Guatemala and Dr. Uhler from the island of Granada.

Pycnoderes Van Duzeei Reut. (n. sp., p. 1.)

Common at Mandeville and also taken at Balaclava and Kingston. Closely resembles *atratus* Dist.

Pycnoderes angustatus Reut. (n. sp., p. 2.)

A larger and more slender species taken with the preceding and equally abundant.

Bryocoris minutus Reut. (n. sp., p. 2.)

Mandeville, two examples. Aspect of a small *Chlamydatus*.

Neocarnus vitreus Dist.

Common at Mandeville and Balaclava and taken also at Montego Bay and Hope Bay. The types were from Panama.

Family Notonectidae

Buenoa antigone Kirkaldy.

One example, a female eight millimetres in length, was brought into the house at Mandeville with water from one of the cisterns that are everywhere used in that part of the island for the domestic water supply.

Family Fulgoridæ
Subfamily Cixiinæ

Bothriocera Signoreti Stal.

I found this species fairly abundant throughout the island and have received an example from Mrs. Slosson taken at Biscayne Bay, Florida. These specimens do not altogether agree with Stal's description of this or any of the other known species. The fuscous markings on the elytra form a distinct transverse stigmatal band followed by a narrow broken pale vitta, a round subcostal spot, and an apical hyaline vitta; the base and sides of the vertex and the tegulæ are also pale. One smaller example from Balaclava seems to approach *bicornis* Fabr.

Bothriocera undata Fabr.

One example taken at Mandeville, April 1st.

Oliarus complectus Ball.

Apparently common throughout the island. These specimens were somewhat smaller than those taken in Ohio, Colorado and at Washington, D. C., now in my collection, but they seem to be otherwise identical.

Myndus crudus n. sp.

Form of *sordadipennis* nearly; a little smaller with a narrower vertex and less expanded front. Color a uniform soiled white. Carina of the head and marginal nervure of the elytra tinged with yellow, the latter slightly embrowned around the apex of the membrane; discal nervures of the elytra slender, whitish, setigerous-punctate; stigma scarcely differentiated. Extreme tips of the tibial spines and tarsal claws black. The anterior margin of the mesonotum has a black cloud that shows through the pronotum but is mostly hidden by the posterior margin of the head. Eyes black; ocelli orange. Tergum in one female slightly embrowned at base and along the median line. Length to tip of the elytra 5 mm.

Described from two examples taken at Hope Bay, April 13th, and one from Troja taken the next day. These insects have the appearance of being immature but on careful examination I believe they have attained their full coloring. If a deeper color is attained later it is possibly a light green as this color is faintly indicated in one example. This species bears some resemblance to *radicis* Osborn but the vertex is shorter and less angled before, the eyes are much more deeply excavated below, the pronotum is narrower, the front is less angled at apex, and the whole insect is smaller and slighter.

Brixia fulgida n. sp.

Size and form of *Cixius pini* nearly. Pale testaceous yellow; narrow elongated disk of the pronoton either side of the middle and the scutellum, its extreme tip excepted, brilliant metallic green; elytra entirely hyaline, slightly tinged with smoky and exhibiting brilliant green reflections by oblique light; nervures brown, the marginal, especially on the costa, heavy and fuscous. Tergum mostly black. Slender edges of the facial carinæ, basal joint of the antennæ, broad inferior margins of the clypeus, lineations of the femora and the anterior and intermediate tibiæ and tarsi, fuscous or black. Length to tip of the elytra 5 mm.

Described from two examples taken at Mandeville on March 30th, from pimento bushes. In this species the vertex is narrow, almost linear, but a little widened at base. So far as I am aware this is the first recognition of genus *Brixia* from America. Its nearest American representative is *Paulia opposita* Fabr. which possesses the same brilliant green coloring on the scutellum. In both my specimens the apex of the abdomen is wanting.

Brixia fuscosa n. sp.

Form and size of the preceding. Pale testaceous brown; metanotum, abdomen in large part, some spots on the pleuræ and the disk of the front black; clypeus, carinæ of the face, pronotum and scutellum, sides of the prothorax, edges of the pleural pieces, and the legs paler; the latter with some lineations and the tarsi, darker or fuscous. Antennæ brown, basal joint whitish. Elytra hyaline, slightly enfumed, exhibiting metallic green reflections by oblique light; nervures, about three spots on the transverse nervures at the base of the membrane, and a marginal cloud at the tip of each apical nervure, fuscous; marginal nervure strong, interrupted with white on each side at the first row of transverse nervures. Length to the tip of the elytra 5 mm.

Described from a single specimen taken at Mandeville, March 31st. This species is closely allied to the preceding but

is very distinct in color and has the front broader above and the pronotum wider.

Subfamily Tropiduchinæ

Tangia sponsa Guer.

Three examples, taken at Mandeville, Balaclava and Hope Bay. This is a broad species of a pale yellowish green color with the head triangularly produced, obtuse at apex, about as long as the width of the head across the eyes. Elytra with a broad costal membrane crossed by numerous oblique veinlets.

Tangia cultellator Walker.

Taken at Kingston, Montego Bay and Hope Bay. This is a slender light green species with the head drawn out in a long slender and linear process fully twice as long as the width of the head across the eyes. The elytra are narrow with the whole surface of the areoles minutely papillate; costal membrane very narrow. This species closely mimics a *Dictyophora* in which genus it was placed by Walker. The type came from St. Domingo.

Subfamily Achilinæ

Catonia intricata Uhler.

Three examples taken at Mandeville, April 3d. Two smaller and darker specimens, probably males, have the rufous tinge at the apex of the costal area quite pronounced, and agree perfectly with a specimen determined as *intricata* by Prof. Ball and kindly sent to me for comparison by him. One larger specimen has the white granulations of the elytra much more distinct. In all there is a dark cloud at the base of the clavus bounded behind by a whitish transverse spot, and the wings are dark smoky brown with fuscous nervures.

At Mandeville I took one example of a very pretty and interesting representative of this subfamily which unfortunately had its head eaten off by ants so it is impossible for me to locate either the genus or species, both of which I believe are new. It is a short compact little fellow, 4 mm in length, convex above, oblong in form, of a piceous brown color with the claval region closely dotted with white and with an oblique white line at the base and another at the apex of the costal area.

Subfamily Derbinæ

Lamenia Uhleri Ball.

I took three specimens of what I am sure is this species at Balaclava, April 4th, and another in an abandoned banana field near Constant Spring Hotel at Kingston. These differ from two of Prof. Ball's types of this species now in my collection in being a shade darker, in having the edges of the facial carinæ slenderly brown, and in wanting the round fuscous spot at the apex of the costal area. They agree with these types in having the marginal nervure around the apex of the elytra very slenderly bright sanguineous; a feature not mentioned by Prof. Ball, and in the form of the male genitalia.

Lamenia flavida n. sp.

A little larger than the preceding species. Fulvous yellow, paler beneath; elytra milky white with a fuscous cloud about the apical margin becoming darker on the stigma, and broken just beyond the apex of the clavus, along the commissural margin of which it is extended to the base. Wings white. Tergum at base, eyes and tips of the tarsal spines black. Plates of the male long, ligulate, widest just beyond the middle, then narrowed to an acute apex.

Vertex short and broad, scarcely advanced before the eyes; front parallel above, abruptly widened below to the base of the broad clypeus. Length to tip of the closed elytra 4½ mm.

Described from four examples taken at Mandeville. In one individual the base of the front and expanded sides of the pronotum exterior to the eyes are infuscated.

This must be closely related to *Cenchrea Heidemanni* Ball and *dorsalis* Westw. but it seems to be smaller with a differently shaped vertex and front, and maculated elytra. I confess I am utterly unable to distinguish between the genera *Cenchrea* Westwood and *Lamenia* Stal. Unfortunately I do not possess Westwood's *C. dorsalis* for a direct comparison of these genera.

Subfamily Issinæ

No representative of this subfamily was taken by me in Jamaica.

Subfamily Ricaniinæ

Colpoptera rugosa n. sp.

Closely allied to *sinuata* Burm. but a little smaller and more slender with a distinctly longer and narrower vertex. Vertex almost rectangular, projecting for about one third its length before the eyes, the posterior margin

more deeply sinuated that in *sinuata*. Front longer and much narrower above, the sides almost angled below, margins sharply reflexed, median carina distinct, either side of which is an arcuated pale line simulating an intermediate carina. Pronotum about as long as the vertex, strongly produced anteriorly in an obtuse angle between the eyes, the sides behind the eyes very short. Scutellum with three parallel longitudinal carinæ and an abbreviated oblique one on either side which meet at the anterior end of the median carina and are subparallel with the fore border of the pronotum. Elytra surpassing the abdomen by nearly one half their length, almost linear, the costa a little expanded near their base; inner ulnar nervure forked beyond the middle, outer ulnar and radial nervures simple; transverse nervures numerous, less so on the clavus and costal area, membrane more irregularly reticulated. Legs short, posterior tibiæ simple. Antennæ short, about as in *Cixius*; first joint very short, second longer, subglobose.

Color light fulvous brown, sometimes darker on the front, middle of the scutellum and elytra, the latter with the costal area and clavus pale, apical margin and a spot beyond the tip of the clavus fuscous; carinæ of the face, pronotum and scutellum paler, apex of the clypeus, base of the second antennal joint, a spot behind the eyes, sides of the genital pieces and tarsal claws black; two transverse bands on the anterior femora, a longitudinal ray on either side of the apex of the front and some marks on the abdomen dark brown. Eyes dark brown or black; ocelli amber yellow.

Described from numerous examples. This insect was abundant everywhere on the island, especially on Lantana bushes. It exhibits considerable variation in the depth of coloring but it is quite distinct in its structural characters from Mexican material I determine as Burmeister's *sinuata*, and from Canon Fowler's figure of that species in the Biologia. I cannot find that Burmeister's genus or species have either of them been properly described and I have therefore included most of the generic characters in the above description. Dr. Melichar now places this genus in the *Ricaniinæ*.

Subfamily Flatinæ

Amphiscepa plana n. sp.

Much smaller than *bivittata*. Of about the same shade of green over the whole insect; a narrow dorsal line, sometimes almost obsolete, and the costa slenderly pale or whitish; orbits of the eyes, ocelli and tip of the first antennal joint whitish; tibiæ toward their apex and the tarsi, a series of concentric linear marks along the commissural and apical margins of the elytra and the oviduct of the female, brown.

Front longer and more nearly parallel above than in *bivittata*. Pronotum shorter at the sides and longer on the middle, anterior margin more produced before, subconical and overlapping the base of the vertex, hind margin almost truncated, not emarginate as in *bivittata*. Scutellum with a small, abrupt and acute pale apex. Elytra narrower, costa not strongly

rounded, almost straight for a space along the middle; nervures strong, darker green. Length 5 mm.

Described from five examples taken at Rock Fort, March 25th. This pretty little green species is very distinct from our northern *bivittata*. *Amphiscepa cartilaginea* Stal from Brazil is about the size of this species but is sufficiently distinct in having maculated elytra, a feebly tricarinated front, and the vertex separated from the base of the front by a transverse carina, not rounded as in this species and *bivittata*.

Acanolonia Servillei Spinola.

One example taken at Appleton, April 9th. This is the largest Fulgorid I took on the island. It was swept from rank vegetation growing along the Siloah River.

Orminis contaminata Uhler?

Montego Bay and Hope Bay, five examples. These do not agree well with Dr. Uhler's description and Prof. Ball thinks them distinct. I have not however enough related material to warrant me in describing them as new.

Ormenis ? albipennis n. sp.

Aspect of *septentrionalis*. Smaller; elytra closely reticulated almost to the apex, with but one row of stronger transverse nervures and these frequently not prominent; inner angle acute and slightly falcate; costa more broadly expanded at base, the costal membrane somewhat narrower with the transverse nervures less oblique. Characters of the head, pronotum and scutellum practically the same as in *septentrionalis*. Length 10 mm.

Color clear green, paler in one example that probably is immature; slender costal, apical and commissural margins of the elytra as far as the tip of the clavus, apex of the tibiæ, tarsi, and edges of the genital segments, brown; the costal nervure within this brown line narrowly pale. Wings white with green nervures.

Described from two examples; a dark yellowish-green specimen from Mandeville, and a paler whitish-green individual taken at Richmond.

Ormenis ? albipennis var. brevis n. var.

A smaller form measuring 8 mm, with the elytra proportionately shorter and its hind angle not at all falcate, about right-angled, was taken by me at Kingston, Mandeville, and Hope Bay. In most of these the venation ef the elytra is somewhat indistinct with the transverse nervure scarcely discernable. Possibly these should not be considered as a distinct variety even, but the characters given seem to be constant.

Ormenis ? herbida Walker? (List of Homoptera p. 470.)

Form of the preceding species but smaller with the hind angles of the elytra more produced and falcate. Pale green, each elytron with three black points, a pair placed obliquely before the middle and near the claval suture, the third about midway between these and the truncated apex; the numerous areoles toward the apex of the elytra more or less conspicuously marked with brown, those about the apical margins forming a regular series of longitudinal brown lines which become radiating at the angles; sometimes a few of the smaller areoles on the disk or toward the base are also touched with brown; tips of the tibiæ and the tarsi and sometimes the cheeks washed with brown.

Vertex very short, reduced to a thickened carina across the front of the truncated pronotum. Front transverse, the rounded sides strongly reflexed and more or less embrowned, median carina strong above, becoming obsolete before the clypeal suture; this suture strongly impressed and nearly rectilinear. Pronotum rather long on the middle, fore margin roundedly truncated, hind margin sub-angularly concave, sides about half the length of the middle line. Scutellum with a prominent median carina, the lateral carinæ scarcely indicated. Elytra narrow, costa almost rectilinear beyond the basal third, the costal membrane of nearly uniform width, with strong, close-set transverse nervures; apex straight or slightly concave, outer angles a very little rounded, inner angles subacutely prominent or falcate. Length 5 to 8 mm.

Description made from twelve examples taken at Kingston, Mandeville, Balaclava, Appleton, Montego Bay and Hope Bay. This species seems to be common on the island of Jamaica. It shows much variation in size and extent of the brown markings in the elytral areoles. The three black points on the disk of the corium seem to be constant although in some examples they become much reduced. One large individual shows a brown line on the claval commissure

This insect agrees in every respect with Walker's description of his *Poeciloptera herbida* except in two points: He says the middle chest is "concave behind" which is not true of any species of this family unless he means that the sides posteriorly are concavely arcuated. He also describes the fore wings as "rounded at the tips". He may have meant that the apical angles were rounded, which is partially true and is a somewhat variable character; or it is possible that his specimen was slightly mutilated. His material was from Jamaica and it seems to me quite likely that this is the species he had before him. If, however, it proves to be distinct I would propose the name **tessellata** for the present form.

Cyarda Melichari n. n.

(*Cyarda punctata*, Melichar, Monog. Acan. und Flatiden, p. 135, pl. 7, fig., 17.) This species is well described and figured by Melichar in his Monograph as cited above. It was common all over the island and especially about Kingston where I beat it from Lantana bushes.

I confess I cannot understand how Stal came to locate Walker's West Indian species of *Elidiptera* (*punctata*, *guianæ*, *punctifera* and *debilis*) in *Cyarda*, especially as he is supposed to have made his synonymical notes directly from Walker's type specimens at the British Museum. Walker's descriptions, in part at least, refer to a *Dascalia* mentioned further on. These describe a broad winged form and cannot possible be so construed as to apply to a *Cyarda*. Dr. Melichar has evidently followed Stal in this synonomy, and, as he has well described and figured the species I think it quite appropriate that it should bear his name. *Cyarda difformis*, Walker's type species from St. Domingo, seems to be quite distinct from this as does also *acuminipennis* Spinola which is also figured by Melichar. Stal certainly had no warrant for placing *acuminipennis* as the type of this genus unless he considered it to be identical with *difformis* Walker, nor had he the right to place his own name as authority for this genus. Walker's discription of the genus was amply sufficient for its recognition and *difformis*, being the only species recognized by Walker, must be used as the type. I have received what I believe to be *Cyarda Melichari* from Florida.

Eurocalia n. gen.

Allied to *Neocerus* Melichar. Head with the eyes a little narrower than the pronotum. Vertex short, transverse, truncated before. Front about as long as broad, basal margin almost rectilinear, or very slightly angularly concave, sides below rounded to the straight clypeal suture. Pronotum subcrescentic, obsoletely tricarinate. Mesonotum moderately elevated, the flattened disk bounded by distinct carinæ. Elytra about twice longer than the width of each, narrowed posteriorly to a rounded apex, commissural margin straight; costal membrane much expanded toward the base, about three times the width of the costal cell, its transverse nervures numerous, mostly simple, along the middle more or less united by a supernumerary longitudinal nervure which runs close to the costal; longitudinal nervures strong, united beyond the middle by numerous weaker transverse veinlets; the costal nervure continued across as a single subapical line beyond which most of the longitudinal nervures are once forked; no obvious second subapical line; clavus with some weak reticulations toward the apex, its

base granulated; gibbous knob at the base of the ulnar nervures minutely granulated and there are a few scattering granules on the base of the costal membrane. Posterior tibiæ bispinose.

Eurocalia collaris n. sp.

Pale greenish testaceous tinged with fulvous brown in places especially across the anterior margin of the head and toward the apex of the elytra; a dark brown collar occupies the declivous anterior margin of the mesonotum and there is an elongated mark of a paler brown color along the commissural margin of the clavus; two approximate points near the anterior margin of the pronotum, a minute line on the tegulæ, and a slender oblique line near the base of the radial nervure, black; two distinct points close to the anterior margin of the vertex, a dot behind each eye, two larger spots on each latero-posterior margin of the mesonotum, a round dot toward the base of the corium close to the claval suture, and two larger spots on the apical third of the corium near the commissural margin, the posterior of which tends to form a broken vitta along the subapical line, dark brown. Spines of the tibiæ and tarsi tipped with black.

Vertex very short, its anterior margin a little elevated, almost carinate, a little sinuated across the middle. Front with three short basal carinæ feebly indicated, the lateral very oblique and placed near the margins which are quite strongly reflexed; apex with a transverse brown cloud next the depressed clypeal suture; viewed from the side the front is quite strongly bent inward and almost horizontal beyond the middle. Pronotum with a very obtuse median carina which may be traced as far as the middle of the mesonotum, the lateral carinæ scarcely indicated, exterior to these lateral carinæ the surface is pitted with brown. Costal margin of the elytra slightly sinuated before the narrowly rounded apex. Wings smoky with strong nervures. Length 10 mm.

Described from one example taken at Hope Bay, April 14th. This species will not fit into any genus described by Stal or Melichar although it comes very near *Neocerus* of the latter author. It is not impossible that some of the species described by Melichar under *Dascalia* might be placed here. His limitation of that genus does not seem to me to be altogether the same as that intended by Stal.

Dascalia grisea Fabr.

Dascalia grisea Fabr. Stal Hemip. Fabr. ii, p. 112.
Elidiptera punctata Walker, List of Homop. ii, p. 332, 1851.
Elidiptera guianæ Walker, List of Homop. ii, p. 333, 1851.
Elidiptera punctifera Walker, List of Homop., Supl. p. 71, 1858.
Flatoides lichenosus Melichar, Monog. Flat. pt. 2, p. 222, 1902.

I think there can be no question as to the correctness of the above synonomy. *Dascalia acuta* Uhler (Proc. Ent. Soc. Wash., iv, p. 514, 1901.) is a very closely allied species if it be not identical, and we may have to add to this synonomy *Elidiptera*

occidentis Walker (List of Homop, ii, p. 331, 1851.) This seems to be a common species through the West Indies and southern Florida. I beat three specimens from bushes along the roadside beyond Rock Fort near Kingston, March 25th and one more at Hope Gardens on April 17th.

Melichar seems not to have recognized this species as he has redescribed it as *Flatoides lichenosus*. He makes *Poecilloptera sinuatipennis* Stal the type of *Dascalia*, but it seems to me it would have been better to have taken the first species mentioned by Stal as the type. That would have made the typical group include those species allied to *grisea* in which the apex of the elytra are rounded and the costa straight, in place of those with truncated vertex and sinuated elytra.

Flatoides ? monilis n. sp.

Near the preceding but paler and more depressed in form with a narrower head and much longer pronotum. Head much narrower than the pronotum. Vertex hardly half the length of the pronotum; short conical; its anterior and posterior margins nearly parallel; its disk strongly depressed before the obtuse apex and less conspicuously so either side. Front long, ovate, one and one half times as long as broad, broadest opposite the lower angles of the eyes, its base angularly prominent, polished; the disk quite strongly depressed leaving the margins, including the apical, prominently reflexed; clypeus long-triangular with its narrow base straight. Pronotum narrow, strongly produced, the narrow rounded apex advanced before the anterior angles of the eyes, posterior edge moderately concave, not nearly reaching the posterior line of the eyes; disk with a broad longitudinal depression either side of the middle leaving three very obtuse slightly divergent carinæ. Mesonotum rather small, the disk flat and bounded either side by a low carina. Elytra ample; rather more horizontal than in *Dascalia grisea*, almost parallel sided; costa a little wavy before the tip which is rounded; costal membrane about three times the width of the costal areole, with numerous simple transverse nervures; longitudinal nervures strong, transverse veinlets rather indistinct, forming about one subapical line which is not very prominent; no transverse nervures in the costal areole, a few faint ones in the clavus. Posterior tibiæ bispinose. Base of clavus tuberculate.

Color pale greenish grey, darker on the pro- and metanotum and base of the elytra. Tubercular base of the front, vertex, longitudinal depression on the pronotum, and sides of the mesonotum, brownish; anterior submargin of the pronotum with a row of about eight or ten black points on either side behind the oblique carinate anterior edge; ocelli large, set in a red annulus. Elytra pale greenish, subhyaline, faintly clouded with smoky toward the apex; a broken submarginal commissural line on the clavus, a dot near the base of the clavus and about three smaller ones on the tubercular base of the elytra, black; a few intra-venal dots around the apex and a suggestion of a wavy transverse line before the subapical line, brown. Length 10 mm.

Described from one example taken at Mandeville, April 3d. This is quite different from any other *Flatoides* known to me and should perhaps form the type of a distinct genus.

Subfamily Delphacinæ

Copicerus irroratus Schwarz.

Not uncommon on various parts of the island. I took them in greatest numbers at Mandeville and Balaclava but also found them about Kingston and at Troja. These are rather dark in color with the sides of the pronotum and scutellum embrowned. A larva taken at Balaclava is whitish, dotted with fuscous on the thorax, wing pads and legs.

Stenocranus (?) saccharivorus Westw.

I took several examples of this insect at Mandeville and others at Balaclava, and at Richmond I swept them in numbers from a coarse grass-like plant that might have been a dwarf cane escaped from cultivation. Unfortunately these were mostly destroyed by the ants on the journey home but enough were left to show well the peculiar characters of the insect. It has much the aspect of a diminutive *Dictyophora*. I hardly believe this can be retained in genus *Stenocranus*. It seems to me much nearer *Tropidocephala* and may form the type of a new genus.

This is a pale green insect with the elytra long, subhyaline, a little embrowned along the inner margin toward the apex, with the nervures green. The vertex is narrow, long conical and produced about one half its length before the eyes. Front narrow, slightly but regularly widened toward the clypeus, with a prominent median carina; viewed from the side the apex is distinctly, subangularly, deflected before the eyes. Ocelli brown. Antennæ conspicuously lineated with black anteriorly. Length to tip of the elytra about 5 mm.

Peregrinus maidis Ashm.

Appleton, April 9th, one example. Mr. G. W. Kirkaldy founded this genus in 1904 (Ent. xxxvii, p. 175) for the reception of the present species. He reports it as found throughout Queensland and on Hawaii. The types were from Florida. The present specimen I swept from vegetation along the Siloah River but its home was doubtless on the sugar cane which was largely grown all along the river.

Macrotomella n. g.

Form broad and stout. Head broad, considerably narrower than the mesonotum. Vertex short, strongly declivous, rounded to the base of the front. Front broad; middle keel forked for its entire length the two branches passing over on to the vertex where they are curved outwardly and meet the lateral keels at the hind margin; clypeus tricarinate. Antennæ short, basal joint not longer than broad. Pronotum tricarinate, about as long as the vertex, truncated behind, lateral carinæ very oblique, straight, reaching the hind edge much exterior to the scutellar carinæ. Scutellum rather short, tricarinate.

This genus seems to be most nearly related to *Jassideus* but the vertex is not at all five angled, being truncated before, and the lateral carinæ of the pronotum attain the hind margin. All the carinæ are strongly distinguished.

Macrotomella carinata n. sp.

Yellowish testaceous; carinæ of the head, pronotum and scutellum white, bordered with black; deflexed sides of the pronotum deep velvety black narrowly edged with white; pleural pieces with some brown spots. Legs lineate with brown which becomes black on the outer face of the tibiæ. Abdomen black marked with pale on the venter. Elytra whitish hyaline; nervures slender punctured with brown, the apical margin slenderly brown. Wings almost as long as the elytra, whitish hyaline; apical nervure brown, discal slender and white.

Vertex almost square, scarcely surpassing the eyes; carinæ very prominent, basal foveæ obsolete but in their place a short median carina. Front broad, sides well rounded, disk divided into three almost equal compartments by the forked median carina. Median carina of the pronotum continuous with that of the vertex; lateral running parallel with the hind margin of the eyes. Sides of the scutellum rather deeply arcuated; lateral carinæ moderately divergent. Elytra but little longer than the abdomen. Oviduct of the female not exceeding the pygofers, pale.

Described from four macropterous females taken at Rock Fort near Kingston, March 25th.

Pissonotus delicatus Van Duzee.

This species was described from a single brachypterous female from California. Later I received a fine series of macropterous and brachypterous females from Mr. Howard E. Weed taken at Agricultural College, Miss., and have myself taken the brachypterous females at Grand Junction and Pueblo, Colorado, Riverton, N. J. and Washington. D. C. All those from Colorado and Mississippi have the apex of the head concolorous, the basal joint of the antennæ in part black, and the femora lineated with brown. Those from New Jersey are darker in color with the abdomen piceous, but do not differ

otherwise. The single specimen I took at Washington has the basal joint of the antennæ pale and the apex of the head black. While in Jamaica I took two brachypterous females at Balaclava and one at Mandeville that have the basal joint of the antennæ pale and the apex of the head piceous as in the Washington specimen. All these females I believe to be but variations of one species. I also took at Balaclava and about Kingston five examples of what I take to be the brachypterous male of this species. These are piceous black, a little paler on the elytra, which are broadly bordered with white at apex. The antennæ, legs, coxæ in part, and the apex of the front are testaceous-yellow with the femora and tibiæ lineated with fuscous. The genital segment is large with the aperature oval and vertical, broadest below, with the basal angles deeply excavated leaving a prominent ventral tooth either side; the plates are difficult to make out but seem to be short, ligulate, slightly curved and reaching about half way to the anal tube. Another male taken with these is macropterous. This has the extreme tip of the scutellum white, the elytra whitish hyaline clouded with smoky at base, the nervures pale testaceous and distinctly punctate, the marginal heavy and fuscous, and on the apex of the clavus is an indefinite brown spot.

I took single examples of two other species of *Pissonotus* but I have been unable to locate the species with this material.

Chloriona nigrifrons n. sp.

Pale testaceous yellow; carinæ mostly white. Eyes, front, cheeks, sides of the clypeus, a few small spots on the pleural pieces, claws, a mark on the apex of the clavus, the apical margin of the elytra, some marks on the tergum and the sides of the oviduct, black.

Vertex rather long, quadrangular, extending for about one third its length before the eyes, basal fovæ obsolete. Front narrow, a little wider below, carinæ pale. Antennæ short, basal joint about half the length of the second. Pronotum short deeply emarginate behind, lateral carinæ strong, curved, parallel to and near the hind margin. Scutellum short, the sides deeply sinuated with the apex large. Elytra reaching the apex of the sixth tergal segment; nervures strong, punctate, the commissural white alternated with black at the apex of the clavus.

Described from one brachypterous female taken at Rock Fort near Kingston, March 25th.

Liburnia seminigra Stal.

Rock Fort, March 25th, six examples; Mandeville, March 31st, two examples. These are all males and agree entirely

with Stal's short description except that in some the frontal fovæ are fuscous or black and the base of the tergum is orange yellow. Two males taken at Biscayne Bay, Florida, by Mrs. Slosson differ only in having the abdomen, its apex excepted, fulvous. At Rock Fort I took with the above males one brachypterous female that I believe belongs here. This agrees with the males in all structural details but it is larger (2 mm.) and entirely pale testaceous tinged with yellow, with the frontal fovæ and sides of the tergum embrowned. The base of the tergum is fulvous as in the male; the elytra are faintly smoky hyaline with the marginal nervure white; oviduct black.

Liburnia Andromeda n. sp.

Allied to *seminigra* but smaller and more brightly colored. Head, pronotum and scutellum entirely black, polished; clypeus, breast, metanotum and base of the tergum and elytra, orange; narrow posterior and lateral edges of the pronotum and extreme tip of the scutellum white; basal joint of the antennæ black, second whitish. Legs pale yellow; apex of the posterior femora and base of the tibiæ embrowned. Elytra reaching the middle of the tergum, pellucid, tinged with orange at base and white toward the apex, marginal nervures fulvous, becoming fuscous around the apex and on the commissure behind the scutellum. Tergum orange at base, black across the middle and on the sides, pale yellow at apex. Venter mostly orange, black at apex.

Vertex almost square, scarcely projecting before the eyes. Front rather broad, a little narrowed above, disk transversely a little convex, carinæ not strongly differentiated. Pronotum short, lateral carinæ curved behind the eyes. Scutellum a little longer than the pronotum, lateral carinæ widely divergent, sharpely defined. Aperature of the pygofers regularly oval as in *seminigra;* constricted dorsally by the lateral teeth which are broad and not prominent, ventral notch shallow, obtuse; styles slender, strongly arcuated at apex; plates narrow below, angularly truncated at apex. Length 1 mm.

Described from two brachypterous males; one taken at Mandeville and one collected by Mr. R. J. Crew near Demerara, British Guiana, April 2d, 1901. The latter specimen has the abdomen almost entirely orange.

Liburnia Teapæ Fowler.

(Biol. Centr. Am. Homop. I, p. 135, pl. 13, fig. 13.)

Taken at Kingston, Mandeville, Balaclava and Hope Bay. This is a very black little insect with the antennæ and legs testaceous yellow. I brought home seven examples which exhibit much variation in the depth of coloring on the elytra. In some these are deep black with a small hyaline area on the costa

beyond the middle. In the other extreme the elytra are hyaline with a fuscous ray through the middle from base to apex toward which it is more or less extended inwardly, nervures punctate.

The only female in the lot differs in being fuscous in place of black, with the narrow edges of the pleural and ventral segments, hind edge of the pronotum, carinæ of the vertex, pronotum and scutellum, and the cheeks, pale. Antennæ and legs yellow as in the male.

Liburnia albolineosa Fowler. (Op. cit. p. 135, pl. 13, fig. 14.)

I took three examples of this pretty species at Kingston. Two of these were swept from a patch of a fine grass growing in a damp railroad ditch. Fowler's description of this species is very inadequate but his figure is excellent and leaves little question about the identity of the species. There seems to be much variation in the amount of black on the elytra. In one example the whitish hyaline areas on the clavus and apex of the costa are so extended as to cover most of the surface. In all my specimens the deflected sides of the pronotum are pale yellow and the frontal carinæ are blackish for most of their length.

Liburnia culta n. sp.

Allied to *pellucida*. Black, somewhat polished; facial carinæ, slender margin and carinæ of the pronotum, apex of the scutellum, commissure of the elytra on the basal half of the clavus; basal fovæ of the vertex, carinæ and slender margins of the scutellum, nervures of the elytra in part, antennæ and legs, testaceous.

Vertex as in *pellucida*, almost square, scarcely produced before the eyes, rounded to the front, the apical triangular fova more acute and elongated. Front narrow, sides almost parallel, fovæ deep black; second joint of the antennæ hardly longer than the first, scarcely expanded, almost smooth. Pronotum as long as in *pellucida*, the lateral carinæ less oblique, the included area more or less invaded with white. Scutellum a little shorter, more convex, with a more slender apex and less distant carinæ. Elytra almost hyaline, a little smoky toward the base and interiorly at apex, the nervures mostly pale becoming blackish along the disk of the corium and toward the apex of the clavus, punctate and forked as in *pellucida*. Abdomen piceous, touched with pale along the margins and on the edges of the segments in places; the metapleura largely pale. Length to tip of the elytra 3½ mm.

Described from two macropterous females swept from a cultivated field at Mandeville, March 31st.

Another form that I believe to be the brachypterous form of the above I took in both sexes at Rock Fort near Kingston,

March 25th. These are tiny little things measuring scarcely more than a millimetre in length. In the color and characters of the vertex, pronotum, scutellum, antennæ and legs they agree with them exactly except that the lateral carinæ of the pronotum are much more strongly divergent as is usual in the brachypterous forms. The elytra, which are considerably shorter than the abdomen, are smoky with the margins whitish hyaline interrupted by a conspicuous black mark on the apex of the clavus, and with the hyaline border sometimes expanded over the basal field of the clavus. In the solitary female example the elytra are nearly hyaline with a fuscous cloud following the claval suture and returning around the apical margin, and the lower surface of the abdomen is mostly testaceous-yellow. It may seem strange to place this insect as the brachypterous form of a species nearly twice its size and I do so with some misgivings, but most of their characters are similar and the moist mountain habitat of the larger form may account for the difference in size.

Liburnia humilis n. sp.

Macropterous form: Pale brownish testaceous. Eyes, tarsal claws, oviduct of the female and abdomen of the male in large part black; elytra subhyaline, nervures testaceous becoming fuscous toward the apex. Vertex subquadrate, deflected before, basal fovæ hardly distinguished, apical very small. Front moderately wide, a very little broader toward the apex which is feebly angularly emarginate at the clypeus. Antennæ rather long; second joint much longer and broader than the first, distinctly crenulated on the edges, apex of the first joint slightly embrowned. Pronotum short with the hind margin strongly, angularly concave, lateral carinæ strongly curved. Scutellum large, deeply sinuated on the sides, lateral carinæ nearly parallel, placed near together, tip broad and obtuse. Elytra as in *pellucida*. Length to tip of the elytra 3 mm.

Brachypterous form: similar to the macropterous but with the front somewhat broader toward its apex and the lateral carinæ as usual more strongly divergent. Length 2 to 2½ mm.

Pygofers of the male quite deeply excavated below, the sides sinuated; plates broad, strongly arched and almost meeting above near the anal tube.

Described from five macropterous examples representing both sexes taken at Mandeville, and seven brachypterous specimens from Rock Fort. This plainly colored little species may be distinguished by the large tibial spur, the broad straight uncolored front and the large second antennal joint.

Liburnia terminalis n. sp.

Macropterous form: Pale fulvo-testaceous; carinæ of the head, pronotum and scutellum pale, the median conspicuously whitish; cheeks, clypeus and frontal fovæ fuscous bordered with black next the pale carinæ, or their entire surface may become blackish. Apex of the first antennal joint and sometimes the base of the second conspicuously black; abdominal segments edged with black. Elytra somewhat narrower than in *pellucida;* hyaline, the punctured nervures pale becoming fuscous toward the apex. Head broad; vertex short, apical fova small; front well narrowed between the eyes, sides subparallel below; first antennal joint slender, about three fourths the length of the second. Length to tip of the elytra 3 mm.

Brachypterous male: Similar to the macropterous but with the front a little wider and paler and the lateral carinæ of the scutellum more oblique. Length 2 mm.

Pygofers of the male roundedly excavated below, the sides scarcely sinuated; plates rather short, ligulate, almost parallel or feebly divergent, somewhat incurved at apex against the margin of the anal tube.

Described from eight macropterous and one brachypterous example, all from about Kingston. One of the males has the abdomen almost entirely black. I took at Mandeville two other brachypterous females that I do not like to place with either of these species although they seem to be very closely allied to *humilis.*

Liburnia ? reducta n. sp.

Macropterous female: Pale testaceous yellow; vertex, face, antennæ and legs brownish; carinæ of the head, tip of the second antennal joint and margins of the eyes paler. Pronotum and scutellum with a broad median vitta bisected by the pale median carina, and a broad lateral vitta behind the eyes, piceous brown. Abdomen and pleural pieces pale marked with dark brown, the tergum trilineate with pale brown; oviduct black; mesopleura with a lateral round piceous spot. Elytra yellowish hyaline with a brownish vitta following the median nervure of the corium to the transverse nervures where it is deflected inwardly; the marginal and apical nervures, the claval commissure and two vittæ on the disk of the clavus brown.

Form broad with a wide head and short vertex, the latter with distinct fovæ; front moderately broad almost parallel, carinæ distinct, apex straight; basal joint of the antennæ almost as long as the second. Pronotum about as long as the vertex, truncate behind, the lateral carinæ divergent, almost attaining the hind edge. Scutellum moderately contracted at apex, sides regularly arcuated, lateral carinæ a little devergent at apex. Length 3½ mm.

Brachypterous female: Scutellum shorter with the lateral carinæ as usual more divergent and the sides nearly rectilinear. Elytra scarcely attaining the second tergal segment, dark brown with pale margins and nervures. The pronotum and scutellum are piceous brown with three pale vittæ following the carinæ.

Described from one macropterous female taken from grass in a damp place by the Railroad tracks just west of the station at Kingston, and a brachypterous female from Mandeville. The broad form and straight lateral carinæ of the pronotum as well as the general pattern of marking separate this species from *Liburnia* but I can find no established genus in which it can be better placed and do not care to found a new genus without access to fuller material.

Liburnia ? dorsilinea n. sp.

Size and general aspect of *Stenocranus dorsalis* but with a broad and short vertex. Dull testaceous brown with a whitish dorsal stripe on the vertex, pronotum and scutellum which is continued slenderly along the elytral commissure to the tip of the clavus; elytra with a brown longitudinal vitta, obsolete toward the base but strongly accentuated beyond the transverse nervures; the surface interior to this vitta darker especially toward the apex, with the nervures fuscous. Wings smoky hyaline with fuscous nervures. Clypeus, legs and lower surface pale becoming whitish on the sides of the venter; oviduct black on either side.

Head broad with a short vertex, the fovæ poorly defined. Front moderately broad, rectilinear, scarcely narrowed between the eyes; apex very feebly emarginate, median carina not strongly distinguished. Pronotum short, posterior margin quite deeply emarginate, lateral carinæ following the curve of the eyes. Scutellum large with the sides regularly arcuated. Length to tip of the elytra 5 mm.

Described from one macropterous female taken at Balaclava April 5th. In color and marking this large species bears a striking resemblance to our northern *Stenocranus dorsalis* but it can at once be distinguished by the short and broad vertex, broad concolorous front, and the curved lateral carinæ of the pronotum. The carinæ are poorly defined.

Family Cercopidæ

Tomaspis bicincta Say.

One example was swept from rank vegetation on a stony hillside at Mandeville, March 31st. In this individual the transverse bands are very faintly visible. It does not differ otherwise from specimens of var. *ignipecta* in my collection from the United States and Mexico.

Clastoptera funesta Stal ?

With the preceding I took one example of a small *Clastoptera* related to *proteus* that I place with some doubt as Stal's *funesta*. It is deep black with a yellow band across the apex

of the front, another on the pronotum, and the base of the scutellum is also yellow. The elytra have a large square black spot on the middle of the costa about which is an arc of reddish salmon color fading to hyaline at apex and along the costa, and to black at base and on the clavus. At the apex of the costa is the usual black dot. Legs whitish dotted and banded with black on the tibiæ and tarsi.

Family Membracidæ

Of this family I took what I believe should be listed as ten species. Five of these I have been able to place with some degree of certainty, the others I have been unable to locate satisfactorily in their proper genera. Some and possibly all these doubtful forms are probably still undescribed but my acquaintance with this family and the material at my disposal is much too limited for me to attempt to describe new forms, nor do I know of a student of the family to whom I could look for assistance. I have therefore contented myself with placing these doubtful species as nearly as I could in their proper sequence leaving their identification for some future time.

Subfamily Smiliinæ

Acutalis calva Say?

Three specimens of what I believe to be this species were taken at Hope Gardens, March 27th, one at Mandeville, April 3d, and one at Balaclava. These are a little smaller than the same species as found in the United States but I cannot see that they differ in any other respect.

Micrutalis malleifera Fowler.

One example taken at Hope Gardens, near Kingston, with the preceding. This individual agrees with Fowler's description in every respect. It is but little more than half the size of the *Acutalis* mentioned above but I can see no possible reason for placing it in a separate genus. In this specimen the pedicellate apical areole is reduced to a mere point but is still quite distinguishable.

Three other species of this subfamily were taken by me that I have been unable to assign to their proper genera. One of these, of which I took a good series, superficially resembles *Trachytalis isabellina* Fowler, figured in the Biologia, Homop.

ii, pl. 7, fig. 25. In the female of this species the elytra are narrowed to an acute apex much as in *Polyglypta*.

Subfamily Darninæ

I took quite a series of what I believe to be varieties of one species belonging to this subfamily. Of the 23 specimens taken hardly two are alike. They vary in size as well as pattern of marking, but all are small.

Subfamily Centrotinæ

Callicentrus aurifascia Walker. (Cat. of Homop. p. 618.)

At Montego Bay I took one female that I believe should be placed here. This specimen has nearly the whole front of the thorax bright yellow, and wants the "stripe of pale yellow down each side of the breast" and the "bright yellow stripe each side beneath the abdomen". It also differs in the color of the tibiæ and in the presence of the band of white tomentum on the sides of the pleural pieces. *Pyramba aurifacies* (n. gen. et sp) Buckton (Monograph p. 248.) is a closely allied species, but apparently wants the white spot on the base of the corium and has the posterior process of the pronotum extended to the apex of the closed elytra. Buckton's genus *Pyramba* is certainly identical with *Callicentrus* Stal but it would not be valid in any case as he gives no indication of the characters on which he purports to found it. Buckton's Monograph is almost worthless for determination; his figures are unrecognizable and the descriptions, so far as I have had occasion to make use of them, are no better, while his nomenclature in places is positively weird. It would be a boon to all students of this group if some entomologist who understands the characters of the Membracidæ would go over Buckton's types while they are still accessible and tell us what they really are.

Callicentrus jucundus Walker. (Cat. of Homop. p. 620.)

I took one male at Montego Bay that agrees in every essential particular with Walker's description. Another male taken at Balaclava, April 4th, differs in being a little larger, of a uniform ferruginous brown color on the head and prothorax and in having a longer and more protracted head with its apex more rounded. The legs also are paler in color and the humeral angles are more rounded and prominent. It does not agree

with any of Walker's other Jamaican species of Centrotus and is probably undescribed.

Stal founded this genus for *Centrotus ignipes* Walker and *flavivitta* Walker. After a careful study of the descriptions and material accessible to me I would place the following species in this genus, all from Jamaica:

Suprahumeral horns broad:

C. *ignipes* Walker. Cat. Homop., p. 616.
C. *platycerus* Walker. Cat. Homop. p. 618.
C. *cribratus* Walker. Cat. Homop. p. 619.

Suprahumeral horns slender, acute:

Prothorax marked with yellow vittæ:

C. *flavivitta* Walker. Cat. Homop. p. 617.
C. *aurifascia* Walker. Cat. Homop. p. 618.
C. *aurifacies* Buckton. Monog. p. 248.

Prothorax without the yellow vittæ:

C. *jucundus* Walker. Cat. Homop. p. 620.

Aethalion nervoso-punctatus Sign.?

While at Mandeville I took two examples of a small *Aethalion* that is very near Signoret's species. A comparison with Mexican material may, however, show it to be distinct.

In placing this genus under the Membracidæ I do not wish to be understood as passing any judgment as to its systematic position. Perhaps a more logical arrangement would be to place it as a separate family of equal rank with the Membracidæ on the one hand and the Bythoscopidæ on the other, and arrange these with the Tettigonidæ and Jassidæ in the superfamily Jassoidea.

Note: I took at Mandeville four examples of a very small brown insect belonging to the Centrotinæ that I have been unable to locate in any described genus. It is a roughly punctured little fellow, two millimetres in length, with the basal one half of the elytra coriaceous and punctured. The pronotum is triangularly produced to about the middle of the abdomen and wide enough to cover most of the scutellum.

Family Bythoscopidæ

Agallia novella *var.* **tropicalis** n. var.

While on the island I took a long series of what I prefer at present to place as a variety of this species. They were most

abundant at Mandeville but I took them also at Balaclava, St. Margaret's Bay, Hope Bay, Richmond and Kingston. These are all smaller than the species as found in the United States, (2½ to 3 mm.), the clypeus is narrower toward the apex, and the sinus of the last ventral segment of the female is much more shallow with the outer apical angles more produced, forming a prominent blunt tooth. The colors vary as widely as in our northern form but the dark males differ from the northern males in having the disk of the pronotum before the middle marked with a more or less extended pale spot bisected by a rather broad black longitudinal line. In *novella* from the United States there is a narrow black median line bordered either side by pale which may be so extended as to cover nearly the whole surface. In the dark Jamaican males the elytra are almost black with a costal area, broadest at the middle, the claval suture, an oval spot at its base, an elongated angular mark on the claval commissure near its apex and the claval surface within the inner nervure, pale yellow, or subhyaline on the costal area. In even the palest females the rounded apex of the clypeus, the lateral sutures of the front and clypeus, the antennal pits, two dots on the vertex, two on the disk of the pronotum, and the basal angles of the scutellum are black; the frontal arcs, the sutures of its base with an abbreviated median line from its angle, a spot on the ocelli, the median line on the pronotum anteriorly and a cloud on its anterior margins behind the eye are ferruginous, and in darker examples become black. In the paler examples the elytra are yellowish hyaline, faintly smoky at apex, with pale nervures, between which are indications of fuscous lines.

The study of material from intermediate localities may make it advisable to raise this form to specific rank but its present assignment will serve to show its affinity with *novella*.

Agallia lingula n. sp.

Allied to *novella* but with the vertex perhaps a little more angulated and the pronotum shorter. Front a little broader than in *novella* with the sides more strongly arcuated, the basal sutures meeting in a more obtuse angle, and wanting the short median line running from the apex of the angle toward the hind edge of the vertex; clypeus a little shorter and more ovate and the loræ broader than in the Jamaican form of *novella*. Last ventral segment of the female short, truncated, with a slender ligulate process, fully as long as the basal portion of the segment; plates more slender than in *novella*, their sides parallel and apices acute. Length scant 3 mm.

Color pale brownish testaceous becoming more yellowish on the head apex of the scutellum and legs; vertex with a round black dot over each ocellus; the latter placed on a brown dot; sutures of the face, apex of the clypeus, pleural pieces, some marks on the base of the vertex and the disk of the tergum, black. Front, except the middle line, some obscure marks on the apex of the vertex, a lobate oblique spot either side of the anterior margin of the pronotum, and the base of the scutellum ferruginous brown; from either lateral angle of the pronotum an indefinite pale ray follows the anterior margin and invades the lobate brown mark; disk of the pronotum discolored posteriorly, the pale color forming a triangular spot with its apex resting on the base of the vertex. Elytra brown, almost unicolorous, a little darker along the commissural margin and apex, nervures pale; nervures of the wings fuscous.

Described from one male and two female examples taken at Montego Bay, April 7th. This species may be distinguished from *novella* by its wanting the black dots on the pronotum and scutellum, and by its having those of the vertex a little farther apart; the pale color of the pronotum also is differently arranged forming a triangular mark on the disk anteriorly in place of a pale area either side of a median dark line. The form of the last ventral segment of the female is also quite distinctive.

Agallia basiflava n. sp.

Allied to *sanguinolenta*. Front broader and shorter than in *novella* with the sides more deeply sinuated below the eye; clypeus narrower and more nearly linear. Last ventral segment of the female long, obtusely triangular, the apex truncated or slightly emarginate. Valve of the male longer than in the preceding two species, plates broad and short, forming an obtuse triangle with its sides feebly sinuated and its apex rounded. Length 3 mm.

Color pale ferruginous brown; face with two dots placed on the ocelli, two others above these on the vertex, antennal pits, and sutures of the front, black; cheeks broadly whitish, subhyaline; orbits of the eyes, a large quadrate median spot on the vertex, excepting the median line and including the four black points, a bilobate median vitta on the front and the sides of the clypeus basally, pale cream white. On the pronotum is a pale border to the dark median line meeting in front and produced either side in a curved wing-like mark that does not quite attain the latero-posterior angle. Scutellum with a black spot within the basal angles and three approximate pale spots on the apical field, the larger of which occupies the apex. Elytra pale brown clouded with darker, especially at apex and in an indefinite oblique vitta before the middle; anterior to this oblique vitta the nervures are broadly yellow, behind they are mostly pale with a few brown interruptions. In pale examples the oblique vitta is indicated by a sagitate blackish mark before the apex of the clavus. Pleural pieces and base of the abdomen blackish; produced tip of the ultimate ventral segment of the female brownish. Legs pale, the posterior tibiæ dusky beneath.

Described from one pair taken at Balaclava, April 5th, another example taken with these, and two others from St. Margaret's Bay, April 12th. This species may best be distinguished from *novella tropicalis* by its wanting the black dots and median line on the pronotum and the black apex of the clypeus. The yellow veins on the base of the elytra seem to persist. The genital characters are very characteristic and in the female seem to ally this species with *tenella* O. & B. from Mexico.

Agallia liturata n. sp.

Form of *constricta* nearly. Front broad, strongly sinuate below the antennæ, apex broad, abruptly narrowed to the clypeus which is somewhat ovate. Last ventral segment of the female short at the sides, the outer angles a little prominent, the middle one third produced and almost square with the apex broadly angularly emarginate. Valve of the male transverse, appearing as an additional ventral segment; plates together triangular, a little longer than broad at base, sides slightly sinuated, apex obtuse. Length 3 to 3½ mm.

Color pale fulvous brown, vertex except the median line and another near the eye, cheeks, loræ, and the usual bilobate median vitta of the front, pale; frontal sutures, apex of the clypeus usually, antennal pits, ocelli, and two dots above them on the vertex black. Pronotum with pale marks forming two arcs beginning at the middle of the anterior margin and diverging to the center of the disk where they are deflected at right angles almost to the inner angle of the eye, behind which they form an oval ring. In dark examples the median vitta, a small spot at the inner angle of the eye and a larger oval one near the basal margin either side of the eye are deepened almost or quite to a black color. Ground color of the elytra brown on which the strong nervures are conspicuous, these are connected by a number of supernumerary transverse nervures in the marginal and apical areoles and on the clavus. Wings deep smoky brown with blackish nervures. Scutellum pale with the basal angles and a median spot dusky. Abdomen pale with the tergum darker and the apex of the ultimate ventral segment dusky. Legs pale, the posterior tibiæ embrowned beneath; tarsal claws deep black.

Described from fifteen examples taken at Rock Fort, near Kingston, March 25th; Montego Bay, April 7th; Richmond, April 15th and Mandeville. This species must bear a very close resemblance to *Balli* Baker (described as *reticulata* by Ball; Psyche, IX, p. 127, 1900) from Hayti but the very different genital characters will at once separate them.

Agallia scortea n. sp.

Form of *oculata* nearly, Vertex very short; face flat; front short and broad, sides feebly sinuated below the eye and rounded to the broad apex; clypeus long, widened apically; loræ rather wide, cheeks strongly angled at about their middle, not attaining the apex of the loræ. Pronotum unusually

long, the latero-posterior margins much extended, posterior margins feebly sinuated, almost entirely covering the basal field of the scutellum. Elytral nervures inconspicuous, ultimate ventral segment of the female but little longer than the penultimate, apex truncated, almost parallel with the basal. Valve of the male inconspicuous, broad triangular, its apex truncated, plates hardly twice the length of the valve, much shorter than the pygofers which together with the plates form a long triangular segment. Length 3 to 3½ mm.

Color a soft fulvous brown. Head pale yellow; two small dots on the vertex placed close to the basal margin and wide apart, a larger angular spot close to the inner angle of the eye, a minute dot below this placed near to the inner margin of the eye, the ocelli and antennal pits, black; on the apex of the vertex is a slightly discolored patch on which may be a basal brown dash or point. Pronotum a little paler about the borders; two small distinct black dots placed well forward on the disk and two minute points close to the anterior margin either side of a slender short median dash, dark brown or black. Scutellum yellowish with the minute acute tip deep black; the incised transverse line brown. Elytra pale, subhyaline, highly polished, the nervures inconspicuous and a little paler; across the middle of the elytra a darker band is indicated mostly by a fuscous cloud near the commissural margin of the clavus. Abdomen dusky beneath; disk of the tergum black. Pleural pieces deep black, edged with pale; feet pale, claws black.

Described from one male and three female examples taken at Mandeville, March 29th, and Montego Bay, April 8th. This very distinct form cannot be confused with any described species known to me. A larger but closely allied species recently taken near Buffalo, N.Y., seems to be still undescribed.

Note:—Agallia repleta n. sp.

Male: General appearance of *4-punctata* Prov. but smaller and more slender. Clear brownish testaceous tinged with fulvous on the face and with yellow on the scutellum. Front rather strongly constricted below the eye; clypeus and a large spot in the antennal cavities deep black; frontal sutures, an angled line bounding its base, an elongated curved line on each side of the front, a dot on each ocellus and a larger round spot above them on the vertex black. Pronotum with five black spots on the disk, one median and four forming a quadrangle of which the anterior are nearer, and on the anterior border is a black line behind each eye. Scutellum with a triangular spot well within the basal angles connected by another on the incised line. Elytra fuscous hyaline with the nervures pale, simple. Beneath black with the connexivum and genital pieces testaceous. Legs fulvo-testaceous. Valve very large, cut square across the broad apex, plates small, triangular, subacute. Length 2½ mm.

The female differs from the male in having the black marks on the face more extended and in having those of the pronotum represented by a curved black line, concave anteriorly, touching the anterior margin at either end, and faint indications of the median and two posterior discal spots. Elytra

Pediopsis elegans n. sp.

Closely allied to *virescens* in form but a little smaller; front broader and shorter, as in *viridis*, but with its sides straighter and apex broader; vertex longer, not as thin and sharply angled as in *virescens;* Pronotum minutely and almost transversely striate; face punctured rather than striate. Ultimate ventral segment of the female long, cylindrical, distinctly carinate along the median line; the middle of the hind edge on either side drawn out into a slender subacute appendage resembling the "tails" on some Papilios. Valve of the male very small but obvious, plates long, convex, triangular, their sides nearly straight, scarcely sinuated toward their smooth acute apex. Length, male 3½ mm; female 4 mm.

Color in fully developed examples clear bright grass green with red markings on the pronotum. Face clear light yellow above fading to greenish toward the mouth, superior surface of the vertex and pronotum deeper green, the latter with the anterior margins and median line posteriorly clear blood red, the hind edge narrowly pale reddish; scutellum tinged with yellow on the basal angles and apex. Elytra somewhat smoky, the costa and commissural nervures green. Connexivum light yellow.

Described from nine examples, representing both sexes, taken at Mandeville, March 29th to April 3d. These were beaten from bushes the names of which I did not learn. When fully colored this is a most beautiful little insect. In immature examples the red color is barely indicated by paler marks. The males are smaller with darker elytra than the females. The form of the ultimate ventral segment of the female is very distinct from anything I have before seen in this genus.

Family Tettigonidæ

Tettigonia histrio Fabr.

This seemed to be a common species at some localities. I took it in numbers in a dry ravine at Montego Bay and in smaller numbers at Kingston. Some of these individuals are suffused with red as indicated by Stal in his description in the

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rather deeper colored with the pale nervures heavier and more conspicuous. Last ventral segment short, cut almost square off behind, but little longer at the middle than at the sides; pygofers rather thick toward their apex, unarmed.

Described from one pair taken on the island of Trinidad by Mr. Chipman. This genus appears to be well represented in the tropics. Messers Uhler, Osborn, Ball and Baker have described quite a large number from Mexico and the West Indies and five more are here added, all of which seem to be sufficiently distinct.

Hemip. Fabriciana. In many however this color is scarcely indicated and in others it is confined to one or more elytral areoles. In two examples from St. Margaret's Bay the black lines are much reduced making them very close to *T. fausta* Walker, from St. Domingo.

Tettigonia histrio var. **sanguinipes** n. var.

Color deep black. Head pale with two broad black vittæ that extend over the vertex and meet at the apex of the front where they form a single median vitta on the clypeus; cheeks with a black vitta below the antennæ and a broken one below the eye. Pronotum black with three longitudinal bands and the lateral margins pale. Scutellum black with a median basal spot and the broad apex pale. Elytra black; corium marked with four pale spots forming incomplete transverse vittæ; the apex smoky hyaline; clavus with four pale spots, the two apical elongated, near the commissure. Wings almost black, highly iridescent. Breast, abdomen and legs sanguineous marked with black on the pleural pieces and disk of the abdominal segments, apex of the tibiæ and tarsi and frequently the middle of the femora black or fuscous. In some specimens the pale markings are deeply suffused with sanguineous, the face may be almost entirely pale and the other pale markings may be so extended as to show clearly its relationship with *histrio*. Through the varieties figured on plate 15, figures 28 and 29 of the Biologia there seems to be a direct connection between *histrio* Fabr. and *Stalii* Sign. The present variety appears to be an extreme form even more distinct than *Stalii*, but the genital characters are the same and I cannot feel justified in describing it as a new species. Length 7 mm.

This variety was common especially in the more elevated and moist localities. It was abundant at Mandeville and I took it at Balaclava, Appleton, Richmond, Hope Bay and St. Margaret's Bay. I did not find it either at Kingston or Montego Bay.

Tettigonia macrocephala n. sp.

Somewhat allied to *gothica* but with a smaller and much more slender body. Head large, much broader than the pronotum, more rounded before than in *gothica;* clypeus more convex. Pronotum narrower, about one third longer than the vertex, almost semi-circular before, feebly concave behind, valve of the male large, rounded behind; plates narrow, subacute at apex.

Color pale yellow tinged with fulvous on the sides of the vertex and with testaceous on the pronotum. Vertex with a broad pale median vitta, angularly expanded before the ocelli, bordered by a brown line; behind the ocelli is a short brown line and exterior to them a brown cloud, temples with a blackish spot on the line between the face and vertex, apex of the head with a round black spot either side of which the frontal striæ are marked with brown where they encroach upon the vertex. Face pale with a short longitudinal brown vitta on the apex of the front and extending over on to the base of the clypeus; cheeks with a brown cloud beneath the eyes. Pro-

notum clouded in places and marked with two broken longitudinal lines continuing those on the vertex, a short curved line behind the inner angle of the eye and the latero-posterior margins dark brown. Scutellum pale with the basal angles and a transverse line faintly brown. Elytra dull sanguineous, the apex subhyaline clouded with fuscous; costa greenish yellow toward the base, nervures dark. Wings deep smoky hyaline. Abdomen yellow beneath, connexivum sanguineous, breast and legs pale yellow, mesosternum with a blackish cloud; tibiæ dotted with brown. Length 4½ mm.

Described from five examples taken at Montego Bay, April 8th. This species seems somewhat closely allied to *compta* and *tunicata* Fowler, figured on plate 18 of the Biologia, but it is smaller, has a broader and more rounded head and the markings on the vertex and pronotum are quite different.

Tettigonia similis Walker.

This pretty little green insect was common everywhere on the island. I took it at Kingston, Mandeville, Balaclava, Montego Bay and St. Margaret's Bay. As pointed out by me in Ent. News (v. p. 155, 1894) Signoret wrongly identified this species with *Helochara communis* Fitch in which error he was followed by Walker in 1858.

Tettigonia fuscolineella Fowler.

Another common species which I took at many places on the island. Prof. E. D. Ball in a letter to me considers this as a mere variety of *bifida* Say, in which he is probably correct. It has however, a shorter head and the markings, which seem to be constant, are somewhat different on the head and pronotum, and in a faunal list it can do no harm to place it under a distinctive name. Canon Fowler's material was from Mexico.

Dræculacephala sagittifera Uhler.

I found this tiny species not uncommon about Kingston and took it also at Montego Bay and Hope Bay. This is the smallest Tettigonid known to me. Some of the smaller males measure but 3 mm. to the tip of the closed elytra.

Xerophlœa viridis Fabr.

Not uncommon about Kingston and taken also at Richmond, Mandeville and Montego Bay. Most of these specimens were of a clear light bluish-green color but a few were washed with brown on the pronotum, scutellum and elytral commissure. I believe Osborn and Ball were quite right in placing *grisea*

Germ , *virescens* Stal, and *peltata* Uhler as synonyms of this species. *X. viridis* and *peltata*, the two forms I have examined, while variable seem to exhibit no differences of specific value.

Gypona unicolor Stal.

Prof. Ball doubtfully determines this as *unicolor* and I can see no good reason for changing it. The hind margin of the last ventral segment of the female is rather broadly and deeply excavated, a character that would ally it with *Germari* Stal.

I took this species at Kingston, Balaclava, Montego Bay and St. Margaret's Bay. It was taken singly on bushes.

Gypona nupera n. sp.

Female : Most nearly allied to *Wallengreni* Stal and *nana* Fowler. Above dark testaceous brown inclining to olivaceous; beneath pale yellow. Head short, about as wide as the pronotum. Vertex of about equal length across its whole width, incised median line and a dot on the hind margins almost behind each ocellus black; ocelli sanguineous, placed before the middle of the vertex and about equally distant from one another and from the eyes; anterior edge of the head well rounded to the front, transversely striated or furrowed, the striæ straight, simple. Front broad and short, strongly and convexly narrowed to the apex, base feebly but distinctly transversely depressed. Clypeus rectangular, about one third longer than broad; cheeks broad, slightly tinged with green. Pronotum about two and a half times the length of the vertex, strongly transversely striate; anterior margin paler marked with a pair of approximate black dots at the middle and a curved brown line and a few points on either side; lateral margin narrowly yellow, bordered within with fuscous. Scutellum with the curved incised line fuscous. Elytra rather short, nervures pale dotted with fuscous, basal one fourth of the costa pale yellow, bordered within by a fuscous line which beyond runs along the costal margin, where it is dotted with pale, to the apical third and is expanded inwardly over the apex of the costal areole; beyond this brown cloud is a clear spot followed by a fuscous one on the tip of the first apical areole; elytral appendix and two or three commissural marks brown. Wings almost black. Tergum ferruginous, the incisures slenderly pale. Legs whitish, the tarsal spines and claws brown. Last ventral segment a little longer than the preceding, the apical margin broadly concavely arcuated with a median notch barely indicated. Length 7 mm.

Described from one female taken at Mandeville, April 3d. I cannot identify this species with any description known to me. The short vertex, testaceous brown color, with dotted nervures and costa, the latter marked with a yellow base and spot toward the apex, and the yellow and fuscous lines on the sides of the pronotum and base of the costa will most readily distinguish it.

Family Jassidæ

Spangbergiella vulnerata Uhler.

I took about eight examples of this pretty species at Mandeville, Kingston and Richmond. These have the red dorsal lines quite widely dislocated where they pass from the pronotum to the vertex. From the descriptions and figures I have seen of this species I gather that usually these lines are nearly continuous and not so closely approximated anteriorly.

Xestocephalus pulicarius Van Duzee.

I took at Montego Bay one rather large clearly marked female that certainly belongs to this species. It was swept from the short grass growing along the roadside just east of the village. This individual has a large quadrate dark spot on the costa beyond the middle and a narrower one nearer the base. The form of the last ventral segment differs in no wise from that found in material taken in the United States.

Xestocephalus brunneus n. sp.

Female: Color a rich soft brown becoming paler on the head and legs; abdomen piceous with the pygofers paler at base. Vertex short and more rounded than in *pulicarius*, with the front immaculate except for a small pale dot above the ocelli. Pronotum short, distinctly transversely striate, a little paler behind the eyes, otherwise immaculate. Scutellum slightly paler on the disk, the transverse incised line dark. Elytra paler beyond the middle, scarcely maculated at base, the discal transverse nervures of the corium and a dot at the tip of each claval nervure obsoletely paler; a quadrate spot on the middle of the costa, a smaller and darker one beyond this, and the broad apex darker, the sutural margin with two pale spots beyond the clavus and there is another opposite to these on either side of the costal spot. By transmitted light the disk of the corium shows faint indications of some of the paler spots found in *pulicarius*. Wings smoky hyaline, iridescent. Ultimate ventral segment short, anterior and posterior margins parallel, leaving the apex subangularly concave, the median notch found in the allied species scarcely indicated; pygofers proportionately shorter and broader than in the allied species. Length about 2 mm.

Described from a female example taken in a small dry gully at Montego Bay, April 7th, and another female taken at Kingston, R. I., and kindly sent me by Prof. John Barlow of the Agricultural College located there. The specimen from Rhode Island is a little larger and darker but seems to differ in no other way from that taken in Jamaica. The four previously described species in this genus show but slight variations in the form of the last ventral segment of the female and the present

species is no exception. I believe however that *brunneus* is a good species that may be distinguished by its uniform rich brown color, with the elytral maculation almost obsolete except at apex.

Xestocephalus ornatus n. sp.

Male: A little smaller than *pulicarius* with the vertex more produced. Clear light lemon yellow. Eyes, a small oval spot on the anterior margin of the pronotum, a transverse band on the base of the scutellum continued across the base of the clavus, a common large quadrangular spot on the middle of the elytral commissure, bisinuated exteriorly and including a central oval spot of the ground color, and three points on the costa opposite to this quadrangular spot, black. Corium less deeply colored and becoming a little smoky toward the apex, and almost white exterior to the black discal mark. Antennæ, legs, and lower surface of the body whitish.

Vertex produced, obtusely rounded at apex, its length three fourths its width at base. Pronotum one fourth longer than the vertex, hind edge rather deeply arcuated, lateral and latero-posterior margins subequal, rectilinear, meeting at a right angle. Valve large, roundedly truncate at apex; pygofers one half longer than the valve, subacutely triangular, sides almost rectilinear, surface armed with coarse white bristles.

Female a little larger. Common commissural black mark reduced to two curved vittæ, connected posteriorly, and including the broad oval discal spot which connects anteriorly with the ground color. Last ventral segment longer than the preceding, apical margin broadly, angularly excavated so as to be nearly parallel with the basal. Pygofers strongly narrowed toward their apex and sparcely armed with white bristles. Length 2½ mm.

Described from two male and two female examples taken at Mandeville. This very pretty little species introduces a new facies in this genus, so far as it is known to me at least.

Xestocephalus bipunctatus n. sp.

A little larger than the preceding. Soiled white tinged with yellow on the scutellum and faintly clouded with smoky toward the apex of the elytra. These latter marked with a conspicuous black dot at about the middle of the commissural margin, a minute brown point anterior and exterior to this, about three blackish dots on the costa, and an obscure one on the inner margin just beyond the apex of the clavus which extends along the transverse nervure for a little space. Face and lower surface tinged with ferruginous; legs whitish with dark tibial spines, the femora lineated with brown. Vertex obtusely conical, its length two thirds its width at base. Pronotum about as in *ornatus*. Last ventral segment of the female and the pygofers shaped about as in *ornatus*, but the former more deeply excavated. Pygofers of the male small, obtusely triangular, armed with stout white bristles. The position of this male as mounted is such that I cannot make out satisfactorily the form of the valve and plates. Length 2½ to 3 mm.

Described from one pair taken at Mandeville. This is a little white insect with much the aspect of a diminutive white *Phlepsius*.

Xestocephalus Balli n. sp.

Aspect of a small *Eutettix seminuda*. White, tinged with fulvous on the vertex, pronotum and scutellum. Front suffused with ferruginous and sending two slightly divergent lines of the same tint over the apex of the head to about the middle of the vertex where they are deflected and end in two brown dashes, anterior edge with a black point close to each eye. Anterior border of the pronotum with a few brown marks and a black point behind each eye, disk with an angulated transverse pale brownish vitta produced anteriorly on the middle and deflected laterally almost to the posterior angles, disk posteriorly with a vague median cloud. Scutellum a little darker toward the base. Elytra white, becoming a little smoky toward its apex; marked before the middle with a strong oblique angulated fuscous vitta widened into a large square blotch on the middle of the claval commissure; behind this on the costa is a small dot at the middle, a larger one on the node and another at the first apical nervure; inner margin with a short oblique fuscous vitta just beyond the apex of the clavus, and the transverse nervures beyond the middle are touched here and there with brown. Legs white; the tibiæ and tarsi spotted with fuscous. Length 3½ mm.

Described from one female example taken at Mandeville April 3d.

Platymetopius loricatus Van Duzee.

Seven examples of a species that I place here with some misgivings were taken by me at Kingston, Mandeville and Montego Bay. Some of these have the face entirely pale yellow, while in others it is quite evenly covered with obscure irrorations, sometimes almost indiscernable, but wherever there is any darker color on the face the pale angulated mark on the base of the front is visible. The females have the last ventral segment about as long as the two preceding united and quite strongly, almost angularly, produced at the middle. The valve of the male is short and broad and rounded behind and the plates are short and arcuated, forming a border to the valve, with a small acute apical prolongation.

Prof. Ball has kindly sent me for examination an insect from the Island of Trinidad that I believe belongs to this species.

Platymetopius nasutus n. sp.

Form and general appearance of *loricatus*. Vertex strongly produced, its length about twice its width between the eyes at base, surface flat and horizontal. Front a little wider toward the apex than in *loricatus*, the

sides of the clypeus a little less arcuated and the cheeks broader and more rounded outwardly. Pronotum unusually short, the hind margins feebly concave. Last ventral segment of the male short, a little angularly excavated behind; valve large, ovately triangular, the apex obtusely angled, plates a little longer than the valve, broad, sides nearly straight, slightly rounded to the blunt apices, edges fringed with long bristles; pygofers considerably exceeding the plates, obtuse at apex. Last ventral segment of the female short, broadly triangular, at apex obtuse; pygofers stout, scarcely exceeded by the oviduct.

Color dark fuscous brown, vertex becoming almost black toward the apex, marked before the eyes with a rather broad transverse white band that is slightly angled and is crossed by from three to five longitudinal dark lines; slender edge of the vertex and a spot at the tip white. Front pale or clouded with fuscous with a white mark at base. In the female from Jamaica the face is clear yellow clouded with fuscous on the cheeks exteriorly, within which are some sanguineous irrorations. Pronotum and scutellum irrorated with pale, the former with four pale longitudinal lines indicated, the latter with the extreme tip and two marginal spots on each side pale. Elytra white, nervures fuscous, areoles rather strongly reticulated and in part irrorated with brown, the oblique costal nervures nine to twelve, strong. In the male the elytra are darker showing the usual white spots quite strongly; the inner apical areole with a white lunule bordered with brown, which forms an annulus when the elytra are closed and is most conspicuous in the female. Wings suffused, with fuscous nervures. Length 4 mm.

Described from one pair: a male from Durango, Colorado, received from Prof. Ball, and a female taken by me at Mandeville. In most of its characters this species is close to *frontalis*. The longer and more clearly marked vertex and the generally paler colors may not be characters of specific value. The genitalia, while of the same general pattern show differences that it seems to me entitle this to specific distinction. The plates of the male are longer and more rounded toward the apex and the last ventral segment of the female is shorter and more triangular.

Platymetopius nanus n. sp.

General appearance of *frontalis* but much smaller. Dark chocolate brown above; entire face pale yellow. Vertex a little more acute at apex than in *frontalis* but similarly marked with an abbreviated longitudinal pale dash at apex, two approximate parallel ones between this and the eye, and a pair of smaller ones at base placed on either side of the dark median line; clypeus distinctly longer than in *frontalis*, considerably surpassing the cheeks, quite strongly constricted toward its base; loræ narrow, outer edges of the cheeks rectilinear. Pronotum almost truncated before between the eyes, very minutely and obscurely irrorated with paler, and showing five indistinct longitudinal lines of pale points. Scutellum with the basal angles blackish and carrying a pale point at the extreme tip of the angles, and

another at each basal angle of the apical field. Elytra with the vermiculations and nervures but little darker than the surrounding surface, white points scarcely obvious except three pairs along the claval commissure of which the basal are very minute; costal area hyaline, broadest posteriorly, and crossed by eleven or twelve oblique nervures, of which four or five are placed close together near the stigmatal region. Propleura yellowish white, polished like the face, with a brown cloud anteriorly and a black spot on the sternum; remainder of the lower surface grey varied with brown. Legs pale yellow; tip of the rostrum and tarsal claws black. Last ventral segment of the female pale at base strongly produced and truncated at apex; pygofers but slightly exceeded by the darker oviduct. Valve of the male very large, semioval, convex, the rounded apex pale; plates pale, narrow, strongly sinuated on the sides, the short slender apicies and edges fringed with pale bristles. Length, male 3 mm; female 3½ mm.

Described from one female taken at Appleton, April 10th, one male from Montego Bay, and one male taken along the railroad track just west of the Kingston station, April 17th. This is the smallest *Platymetopius* known to me. It may be recognized by its close resemblance to *frontalis*, but the entire face and most of the propleura is pale yellow and the form of the male genitalia is very distinct.

Platymetopius brevis n. sp.

Most nearly related to *fuscifrons* but smaller with a still shorter vertex. Color above greyish testaceous much as in *cinereus* O. & B. Vertex short, triangular before, scarcely more produced than in certain species of *Deltocephalus*; quite strongly tinged with fulvous; median furrow generally a little darker, disk marked either side by an oval pale spot opposite the anterior angle of the eye and a dart at base, another pale line follows the inner margin of the eye a little way from its base; extreme edge of the head with five ivory white spots which show above as a median spot and a ring about each ocellus. Pronotum very short at the sides showing five distinct longitudinal pale lines. Scutellum tinged with fulvous, the incised line black; basal angles of the apical field pale. Elytra with the nervures and reticulations strong, brown; the areoles with some white spots and mostly bordered with minute pale points; costal field broad with from eight to twelve strong oblique nervures. Wings highly iridescent. Face pale yellow, closely covered with fuscous irrorations which omit a slender median line and some short arcs on the front and most of the clypeus and loræ; base of the front with a white point, sutures black; disk of the cheeks with a small blackish cloud; clypeus not exceeding the cheeks, moderately widened at apex; loræ large. Beneath brown, pleural pieces edged with pale, the propleura with an oblique pale vitta. Legs pale dotted with brown. Last ventral segment of the female short, moderately produced, with a pale discal spot on either side of the median line; oviduct scarcely longer than the pygofers, blackish on the sides. Valve of the male large, apex slightly angled and appressed, plates long, acute at apex, their sides but slightly sinuated; black, fringed with black bristles. Length 3½ mm.

Described from one male taken at Mandeville, March 30th, and three females from Kingston. This species may be distinguished by its short vertex, the five polished white dots on the anterior edge of the head, the infuscated face and the pale point on the base of the front.

Deltocephalus flavicosta Stal.

Common and widely distributed in Jamaica. All the specimens brought home were of the pale variety described by Stal from Brazil and lately redescribed by Dr. Uhler from St. Vincent as *D. retrorsus*. The darker northern form described by me in 1892 as *D. flavocostatus* is probably identical with Stal's species, as pointed out by Prof. Baker some years ago, although the male plates are narrower and the last ventral segment of the female is more produced and not sinuated as in the southern examples. In the United States this form is common throughout the southern states and is distributed west at least to Kansas and Iowa and northwardly to western New York.

Deltocephalus senilis n. sp.

Size and general appearance of *Sayi* to which it seems to be related in the form of the facial pieces, vertex and pronotum. Vertex with the anterior margin and median vitta ivory white, the former carrying six brown points, one either side of each ocellus and a fainter pair at the tip; the median vitta bisected at base by an incised brown longitudinal line. Pronotum with five longitudinal pale lines which may be more or less distinct. Scutellum paler at tip. Elytra a little narrower than in *Sayi* but of the same length and with similar venation; nervures pale, most of the areoles more or less distinctly edged with brown and a few carrying fuscous spots; most persistent of these is a rather large one on the sutural margin of the clavus a little before the middle and a somewhat fainter one on the corium exterior to and behind this. Face brown, darker above; about eight arcs on either side of the front, an indistinct median vitta, a discal spot on the clypeus either side of the median line, and the disk of the loræ and cheeks below, pale. Body and beneath brown varied with pale, the tergum in some examples almost black. Legs pale more or less distinctly banded and spotted with brown; apex of the last ventral segment of the female feebly bisinuated forming three rounded teeth, the middle a little the larger. Valve of the male very short; plates short, rapidly narrowed to a rather slender point. Pygofers prominent beyond the plates and armed with short bristles. Length 1½ to 2 mm.

Described from 15 examples, representing both sexes, taken about Kingston from March 25th to April 17th; and one from Richmond taken April 15th. In the paler examples the dark marginal dots on the vertex are almost obsolete but the pair

adjoining the ocelli is always discernable. Generally there is a fuscous vitta on the apex of the elytra which is interrupted by the pale nervures. Prof. Ball suggests that this may prove to be an extreme variety of *flavicosta*.

Deltocephalus nigrifrons Forbes?

I took a single male example of what may prove to be a small form of this species at Rock Fort, near Kingston. This individual has the vertex distinctly longer and more angled than in my northern material of *nigrifrons*. It may represent a new species but in the present unsettled state of the synonomy of this species I prefer to leave it here with a mark of doubt.

Athysanus exitiosus Uhler.

This was a very abundant species everywhere I collected on the island especially at Richmond where I found them in great numbers on grass along the roadside. These were smaller and darker than those from the United States, the males in particular sometimes were almost black.

Eutettix Balli n. sp.

Form nearly of *Johnsoni* but smaller with a shorter vertex. Pale testaceous yellow. Two minute points on the base of the front, two larger ones on the ocelli, a pair of minute ones on the vertex between the latter, a round spot on each side of the pronotum behind the eyes, and two marginal points on either side of the scutellum, black. Elytra with a few brown marks. Front rather narrow toward the apex, clypeus, loræ and cheeks about as in *Johnsoni;* the antennal pits deep and marked by a blackish spot; vertex sloping, anterior edge rounded, scarcely longer on the middle than next the eye, hardly one half the length of the pronotum. Pronotum with a transverse spot on the disk and an angular mark anteriorly bisected by the nearly obsolete pale median line. Anterior field of the scutellum with minute brown points on the middle, the edges a little paler marked with two black points on either side. Elytra subhyaline, golden brown with coppery reflections from the highly iridescent wings beneath; clavus with a fuscous cloud at apex of each areole and a fuscous point near the base; corium with two fuscous discal spots before the middle, the anterior smaller and placed on the transverse nervure, apical areoles very slightly enfumed, the inner apical nervure a little infuscated, base of the two outer anteapical areoles with brown points. Breast and legs pale, the posterior tibiæ dotted with brown. Metanotum black. (Abdomen wanting.) Length to tip of the elytra 4 mm.

Described from a single example taken at Montego Bay, April 8th. This very distinct species may be known by its pale color, the four black points on the vertex in a transverse row, and the two conspicuous round black spots on the sides of the

pronotum behind the eyes. It affords me pleasure to name this neat little species for my friend Prof. Elmer D. Ball who has very kindly assisted me in the determination of some of the doubtful forms here enumerated, and whose unfailing energy has added so much to our knowledge of the North American Homoptera.

Phlepsius cinereus Van Duzee.

I found this species in numbers on low tangled vines and herbage along the roadside a little north of the village of Richmond on April 15th.

Acinopterus acuminatus Van Duzee.

Richmond, April 15th, three examples. Two of these were swept from grass and weeds along the roadside in company with the preceding species. They seem to differ in no respect from our northern specimens.

Scaphoideus fasciatus Osborn.

I took two examples of this species at Mandeville, March 30th, and a third from near the railroad track a little west of the station at Kingston, April 17th. These agree in all respects with a pair in my collection taken by Mrs. Annie Trumbull Slosson at Biscayne Bay, Florida, and an example taken by me at Rivington, N. J. With the Rivington specimen I took what I place as the typical *sanctus* Say. Prof. Osborn has fully indicated the characters by which these closely allied species may be distinguished and I quite agree with him that for the present at least they should be considered distinct species.

Thamnotettix colonus Uhler.

Taken at Hope Gardens and near the Constant Spring Hotel at Kingston, at Mandeville, and from Richmond, where they were common in a pasture on the hillside above the town. The types were from the Island of St. Vincent. Dr. Uhler placed this species in genus *Deltocephalus* but it seems to me that its affinities are rather with *Thamnotettix* although the front is somewhat broader than in our more typical species.

Thamnotettix comata Ball.

I took numerous examples of this species at Kingston, Mandeville, Balaclava, Hope Bay, and Richmond. These differ from Ball's description in wanting most of the black markings above except the two large round spots on the vertex

and two minute brown points between them on the apex of the head. I have however in my collection specimens from Washington, D. C., and Florida that were determined by Prof. Ball as his *comata* and agree with these Jamaican specimens in every particular. Like the preceding species this was described as a *Deltocephalus* but it seems to me that its affinities are with *Thamnotettix* where I prefer to place it. In form and ornamentation these specimens agree almost exactly with *colonus* Uhler, but they are much smaller and are sufficiently distinct in their genital characters. The types of *comata* were from Mexico.

Thamnotettix rubicundula n. sp.

Female: Form of *placida* Osborn, nearly, but much smaller. Pale yellowish tinged more or less strongly with sanguineous. Vertex short, a little longer on the middle than next the eye, moderately sloping, the edge well rounded to the base of the moderately broad front; clypeus narrow; cheeks feebly angled below the eye. Sides of the pronotum short with a thickened carina. Face, lower surface and tergum more deeply suffused with sanguineous than above. Legs pale tinged with red, especially the anterior pair. Tergum black on the disk. Last ventral segment with a narrow but deep and rounded sinus the mouth of which is contracted by a projecting tooth, either side of which the apical margin is feebly sinuated; pygofers stout, scarcely exceeded by the oviduct. Elytra subhyaline, nervures rather strong, pale sanguineous. Length 3½ mm.

Described from one female example taken at Rock Fort near Kingston March 25th. This species is so distinct from anything known to me that I do not hesitate to describe it from a unique specimen.

Thamnotettix fessula n. sp.

Form of *placida* Osborn but much smaller with the vertex more produced. Clypeus slightly widened at apex; cheeks broad, prominently angled below the eye, the edge beyond almost rectilinear, forming a broad margin exterior to the small loræ. Last ventral segment of the female rather short, the outer angles rounded either side of a rather broad median sinus, at the center of which is a spatulate tooth similar to that found in *clitellaria*, but shorter.

Color fulvo-testaceous, somewhat paler on the vertex, scutellum, elytral nervures and beneath; vertex with a slender median line at base and a small oval spot just above each ocellus ferruginous; the facial incisures and a series of arcs on either side of the front pale ferruginous. Eyes, claws and oviduct blackish. Length 4 mm.

Described from a single female specimen taken at Mandeville, April 3d. This species approaches *Chlorotettix* in some of its characters.

Chlorotettix viridia Van Duzee.

Taken with the following species at Richmond and about Kingston but in less abundance. Its slightly larger size, deeper green color and different form of vertex and the distinct genital characters will readily distinguish it.

Chlorotettix minima Baker. (Can. Ent. xxx, p. 220, 1898.)

Appleton, April 9th, two examples swept from rank grass along the Siloah River; Troja, April 14th, one example swept from grass by the railroad track. At Richmond I took it in numbers from a springy spot in a hillside pasture on the Alexander property and also took it at St. Margaret's Bay and Kingston. These specimens agree perfectly with Baker's description and I cannot doubt their identity. The species is very close to my *galbanata* and has almost the same form of vertex and ultimate ventral segment in the female. It is however considerably smaller and seems to be sufficiently distinct.

Chlorotettix Tethys n. sp.

Form of *lusoria* but much smaller. Vertex subangularly produced; clypeus broad, of equal width throughout, sides rectilinear, cheeks narrow, feebly angled beneath the eyes, forming a narrow margin around the ample loræ. Pronotum with a rather pronounced callous parallel to the anterior margin, the disk behind this distinctly transversely striate. Last ventral segment of the female moderately long, with the outer angles rounded and a little prominent, leaving a shallow median sinus on which rests a brownish cloud.

Color pale greenish luteous, more or less tinged with fulvous; the commissural margin at apex and some vague marks along the base of the apical areoles faintly smoky. Disk of each elytron with two small brown specks, one placed just beyond the transverse nervure near the base of the corium and a smaller one before this lying against the claval suture; elytral nervures pale; eyes, tip of the rostrum, tarsal claws and sides of the oviduct blackish. In one example the anterior submargin of the pronotum shows a sinuated darker vitta similar to that seen in certain species of *Cicadula*, and the basal angles of the scutellum may be darker. Length 4 to 4½ mm.

Described from three female examples; two taken at Kingston, April 11th, and Hope Bay April 13th, and a third taken on the Island of Martinique, July 26th, by Mr. August Busk and kindly sent to me for study by Prof. Ball.

Jassus merus n. sp.

Deep black. Vertex with the basal margin, an incomplete median line, and the carinate sides opposite the inner angles of the eyes, pale; face and deflected sides of the pronotum pale yellow, immaculate; antennal seta brown; base of the eyes pale; legs whitish, the claws and upper surface of

the hind tibiæ black; sides of the pleura, a transverse vitta on the mesopleura, the edges of the connexivum and the oviduct whitish; margin of the posterior field of the scutellum in part and the slender hind edge of the pronotum, a spot on the elytral commissure just beyond the apex of the clavus and another opposite to this on the costa, the apical margin and slender costal nervure pale yellowish or soiled white.

Head distinctly narrower than the pronotum. Vertex narrow, much contracted by the approximated inner angles of the eyes where the width is about one third that at apex. Front narrow with a submarginal furrow above the antennæ; clypeus broad at apex. Pronotum short, about two thirds the length of the vertex, hind edge feebly emarginate, surface transversely rugose; basal field of the scutellum shagreened; elytra narrow, nervures strong. Length 5 mm.

Described from a single female example taken at Mandeville. This is a small slender species with a narrow head and vertex, and would fall into section "EE" of Spangberg's arrangement. The deep black of the upper surface is strongly contrasted with the pale yellow of the face and legs beneath. The pale markings on the elytra suggest the possibility of a pale vitta on the transverse nervures and more or less paling of the nervures toward the base, but allowing for such variation the species seems to be quite distinct.

Cicadula intensa n. sp.

Allied to *punctifrons* in form and pattern of marking, but smaller. Vertex flattish, sloping, very obtusely angled before, scarcely longer on the middle than next the eye. Front rather narrow; clypeus oblong, distinctly constricted toward its base. Pronotum proportionately longer than in *punctifrons*, the hind edge distinctly concavely arcuated, posterior angles prominent. Elytra as in *punctifrons*.

Color soiled white tinged with yellow on the vertex and scutellum. Front with a pair of large round black spots on its base and a few short brown arcs on either side below. Vertex with a transverse black vitta passing just behind the large brown ocelli, posterior to which is an incised median line and a pair of small discolored points. Pronotum with a sinuated dusky band behind the calloused anterior margin as is frequently the case in this genus. Scutellum with an intensely black elongated spot within the basal angles; about half of this spot is covered by the pronotum through which it may be seen. Elytra white with a brown cloud at apex; the disk of the areoles mostly fuscous, paler toward the costa. Beneath whitish with small black spots on the pleural pieces. Legs white with a few brown points. (Abdomen wanting.) Length 4½ mm.

Described from a single example taken at Hope Bay April 13th. This specimen is apparently a female but unfortunately its abdomen was broken off and lost in transit from the island.

The species however is so distinct that it seems safe to describe it from an imperfect example.

Cicadula sex-notata Fallen.

I took numbers of this species at Rock Fort near Kingston on March 25th. These differ in no respect from those found in the northern states except that they are smaller, measuring but 2 to 2½ mm. to the tip of the elytra.

Balclutha sp.

Rock Fort near Kingston, two examples. This genus, formerly known as *Gnathodus*, is difficult to study without more material than I have at my command. The present species seems to be most nearly related to *viridis* Osborn but differs in some respects.

Balclutha sp.

Two examples of another species I cannot determine were taken at Rock Fort. These are marked with black somewhat as in *abdominalis* but have the ocelli distant from the eyes and do not pertain to Baker's genus *Eugnathodus*.

Eualebra rubra n. sp.

White; base of the pronotum, scutellum and basal one half of the elytra orange red marked with irregular dots of purple-black. These dots are composed of minute purple points on a whitish ground which in most cases they almost entirely cover; they are arranged as follows: three small ones on the base of the vertex; three larger ones on the anterior submargin of the pronotum, the median ovate, the lateral elongated and somewhat angled and almost attaining the humeral angles; a small one on the propleura; a square median one on the base of the scutellum; a very minute one at each basal angle of the scutellum and the basal angles of its apical field; three on the clavus, the median of which is larger and irregular; and five on the corium, one basal, a larger median one almost divided in two, and three beyond this is a transverse row forming a line with the posterior spot on the clavus, the two near the costa very small; the spots in the terminal row are more open, showing the minute dots on the pale ground plainly. The red color on the elytra terminates very abruptly with a broken indistinct brown line; the apex of the elytra beyond this line pale yellowish hyaline, immaculate, with the nervures indistinguishable. Apex of the wings pale yellowish hyaline, the base beneath the red portion of the elytra clear smoky hyaline, iridescent. Beneath white with the clypeus and a point on the disk of the plates of the male black; disk of the venter embrowned.

Vertex strongly angularly produced, the anterior edge thickened and rolled over on to the base of the front; apparently notched above the base of the antennæ. Front strongly depressed, flat and horizontal and sunken below the level of the cheeks and tumid basal margin. Length 2½ mm.

Described from one male taken at Hope Gardens near Kingston, April 18th, the last evening of my stay on the island. In this example the base of the scutellum has been somewhat injured and the square basal spot may be in the form of two parallel longitudinal vittæ. Prof. Baker in describing the type species says: "Face in the single specimen collapsed in drying", my specimen however is a well developed adult and I believe the sunken face to be characteristic of this genus which is very distinct in its general facies from any other known to me. It was founded in 1899 (Psyche viii, p. 402,) for the reception of the Brazilian species, *Smithii* Baker. Later (Invertebrata Pacifica i, p. 7, 1903,) Prof. Baker described a second species, *notata*, from Guatemala.

Protalebra apicalis n. sp.

Soiled white marked with black, orange, and pale yellow. Head ivory white; vertex quite strongly produced and angled before, convex; ocelli distinct; basal joint of the antennæ tinged with yellow. Pronotum one and one half times as long as the vertex; hind margin distinctly concave, the posterior angles prominent, subacute; orange, with the deflected sides and a large rounded median spot resting on the base whitish. Scutellum ivory white with the small basal angles brownish. Elytra whitish hyaline; a basal curved band on the clavus following the sutural margin from the base to about the middle where it is abruptly deflected to the commissure, and a small spot just beyond this on the corium against the claval suture, sometimes vaguely extended basally in a broken band parallel with that on the clavus, orange; apex of the elytra from just before the transverse nervures fuscous, with the nervures yellow and the disk of the areoles mostly hyaline; the extreme apical areoles are bordered with blackish; before this fuscous apical area are some vague pale lemon yellow marks covering the apex of the clavus and forming a broken oblique band toward the middle of the costa. Beneath and legs white with the apex of the abdomen and genital pieces yellowish. Last ventral segment of the female long, quite strongly produced in the middle where it is minutely tipped with brown; sides of the pygofers sometimes with a curved vitta; plates of the male long triangular, their sides straight and ciliated and their subapex with a triangular blackish mark. Length 3½ mm.

Described from one male and five female examples taken at Mandeville, April 1st. In its pattern of marking this species seems to be allied to *Alebra sanguinolinea* Baker from Nicaraugua, (Invert. Pacifica i, p. 5, 1903,) but the colors are much paler and it certainly is a *Protalebra* as the marginal vein of the wings is returned but a short distance around the apex.

Protalebra bifasciata Gillette.

(Proc. U. S. Nat. Mus. xx. p. 711, 1898.)

I took one example of this very distinct little species at Rock Fort on March 25th. This has the black spot on the scutellum and base of the clavus very intense but narrow, not reaching more than half way to the costa. The types were from Brazil.

Protalebra omega n. sp.

Near *vexillifera* Baker. Smaller than *apicalis;* marked with white, orange and golden brown. Vertex quite convex and strongly produced, whitish with two approximate points behind the apex and a large discal spot dusky. Pronotum milk-white; a large oval orange spot occupies the apex anteriorly, deflected sides behind the eyes including the humeral angles reddish orange. Scutellum fulvous at base, whitish at apex, with the slender edges and apex minutely black. Elytra light golden brown with a broad curved milk-white vitta beginning on the claval commissure just behind the tip of the scutellum, touching the costa at about its middle, and then deflected inwardly and backwardly where it becomes narrower and terminates just before the middle of the transverse nervures. This white vitta is slenderly bordered with black exteriorly at base and with fuscous within and exteriorly at apex, and with the elytra closed forms a conspicuous and almost perfect mark the shape of the Greek letter omega; Apical areoles hyaline, a little smoky at tip and bordered costally by a curved fuscous marginal vitta which is deepened to a black spot on the node. Beneath and legs whitish; the posterior tibiæ dotted with black. Last ventral segment of the female strongly triangularly produced almost to the middle of the pygofers, the latter with stout black and white bristles. Length about 2 mm.

Described from two female examples taken at Rock Fort, March 25th. This is a small but very pretty species that must be related to *vexillifera* of Baker, but it is quite distinct.

Protalebra octolineata Baker. (Invert. Pacifica, i, p. 7, 1903.)

Two males and two females of this neat little species were taken at Rock Fort at Kingston. I also found it in numbers on Lantana bushes along the path to the office of the Hope Gardens. In my examples the vertex is soiled yellowish with the median line darker; a line either side of this and another adjoining each eye paler. The common dark median line of the pronotum and scutellum is bordered on either side by paler; anterior submargin of the pronotum with a narrow pale yellow callous and there is a smaller one behind each eye; the calloused slender lateral edges whitish. The four parallel slender black lines on the elytra are well described by Baker but he fails to say that the included area between them is whitish hyaline

where it crosses the disk of the elytra. The transverse lines on the apical areoles seem really to be one line strongly folded on itself, forming a large transverse loop in the apical areoles, at the costal end of which is a fuscous cloud. The extreme apex of the elytra has a narrow fuscous marginal vitta. Wings faintly smoky hyaline with fuscous nervures. Tip of the rostrum and tarsi and apex of the hind tibiæ and a large spot on the prosternum black. Apex of the pygofers of the male and of the oviduct of the female, and a transverse cloud at the apex of the last ventral segment of the female, black. Sometimes the pale markings on the vertex and pronotum are almost obsolete, but the dark median vitta and the black lineations seem to be constant. Although more strongly marked than Baker's specimens from Nicaraugua and Mexico seem to have been I have no doubt but they represent the same species.

Protalebra brasiliensis Baker. (Psyche viii, p. 405, 1899.)

I found this insect very abundant everywhere in the warmer parts of the island, especially about Kingston. These have an abbreviated brown vitta on the base of the vertex, and the hyaline spots in the fuscous areas of the elytra are larger and regularly placed: two on the median transverse area, one at the tip of the clavus, another near this on the corium and the third larger resting on the costa and usually tinged with yellow; and three on the apical area, two medial and a larger one on the costa; and the extreme apex is usually whitish. I have received exactly this same form from Mrs. Annie Trumbull Slosson, taken at Lake Worth, Florida. All these agree so closely with Baker's description that I feel little doubt of their identity. The concavely arcuated posterior margin of the pronotum with prominent posterior angles seem to be characteristic of this genus.

Empoasca mali LeBaron.

Rock Fort near Kingston, two examples; Mandeville, one example. These specimens agree in every particular with those in my collection from various parts of the United States except that they are a little smaller.

Empoasca flavescens Fabr.

One example taken at Mandeville March 30th, appears to be specifically identical with specimens determined for me by Prof. Gillette as *flavescens* of Fabricius.

Empoasca sp.

One example taken at Montego Bay, April 8th seems to belong to a still undescribed species. It is near the preceding but has the vertex a little longer and fuller and the base of the front suffused with yellow. Among the material taken at Mandeville is one more large specimen, apparently an *Alebra*, too immature for determination.

Typhlocyba pseudo-maculata Baker.

(Invert. Pacifica, i, p. 8, 1903.)

One pair of this obscure little species was taken at Rock Fort. They agree in every respect with Baker's short description and I have no doubt of their identity. The female has the extreme apex of the oviduct black.

Additions

The following species were omitted from their proper place in the list:

Edessa bifida Say.

Not uncommon at various places on the island. I have records of Mandeville, Balaclava, Appleton and St. Margaret's Bay.

Podisus sagitta Fabr.

I found this species fairly abundant at Rock Fort near Kingston, Mandeville and Balaclava and took one example at Hope Bay.

Pachygrontha bimaculata Distant.

One example taken at Port Antonio in a little grave yard on Richmond Hill, April 12th. This specimen differs from Distant's short description only in having the apex of the third antennal joint concolorous. It has the sides of the pronotum rectilinear a character not mentioned by Distant but one which would ally it with *longiceps* Stal, but its small size and general characters are so close to those given by Dr. Distant for his *bimaculata* that I prefer to place it there.

Index to new genera, species, etc.

This index includes the names of new genera, species and varieties described in the preceding pages, new names proposed, and also the names of the new genera and species described by Dr. Reuter from material taken by me in Jamaica and recorded in this paper.

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BULLETIN

of the

BUFFALO SOCIETY OF NATURAL SCIENCES

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Buffalo Society of Natural Sciences

HISTORICAL SKETCH

BY

HENRY R. HOWLAND

BUFFALO, NEW YORK
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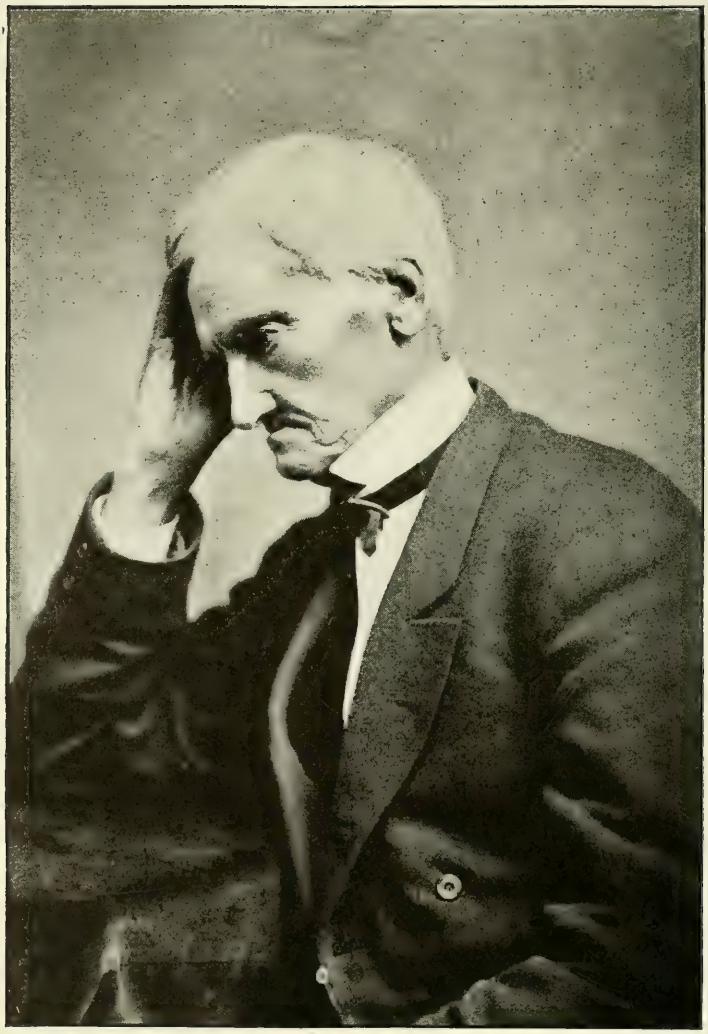


Hon. GEORGE W. CLINTON

First President Society of Natural Sciences

BULLETIN

of the

Buffalo Society of Natural Sciences

VOLUME VIII No. 6

The Buffalo Society of Natural Sciences

HISTORICAL SKETCH

by

HENRY R. HOWLAND

The earliest effort in the City of Buffalo to organize a society for the study of Natural History dates back to April 10, 1858 when eight or ten boyish enthusiasts agreed to meet every Thursday evening, for interchange of scientific observations, at a room in the Granite Block on Main Street, where they discussed the first chapter of Genesis, the value to science of Hugh Miller's labors or those of Dr. Edward Hitchcock and other like grave subjects and out of their slender funds subscribed for the Scientific American and the Horticultural Magazine to aid their budding endeavors.

At first they called themselves "The Buffalo Natural History Society", but that did not suit them and after changing their title to "The Buffalo Scientific Society" and trying its effect for a few months they finally decided to be known as "The Lyceum of Natural Science" a name which they retained during the year or two of their somewhat brief existence. In April 1859 they rented a room in the Harvey Block for $25.00 per annum and continued their meetings until December 14th of that year when they determined to give up their room "unless circumstances become more favorable to our continuance in it than they are at present". Apparently "circumstances" were adverse, for here their meetings ceased; but among these early devotees of science were Henry S. Sprague, Wm. M. Stewart, James H. Hall and Edward C. Taintor, who a little later shared in the organization of the Buffalo Society of Natural Sciences.

Already reference had been made at some of their meetings to the formation of a new Scientific Association, but the thought seems to have slumbered until at the suggestion of Coleman T. Robinson six enterprising young men met on the evening of October 5, 1861 at the studio of Charles Caryl Coleman on East Swan St. near Main, where the Ellicott Square now stands, to discuss the organization of "A Natural History Society". Those present constituted themselves a committee to further the project and when they met again a week later they reported 113 names for possible membership. Other preliminary sessions followed and Thursday evening, November 21, 1861 a larger meeting of those interested was held at Odd Fellow's Hall when a form of Constitution and suitable By Laws, submitted by R. W. Haskins, David Gray und Coleman T. Robinson who had been appointed a committee for that purpose, were discussed, a primary election held and a call issued through the newspapers for a general meeting at Lower St. James' Hall on the evening of Thursday December 5th.

At this meeting Judge Clinton presided. The constitution was adopted, its first provision being that the Society should be called the "Buffalo Society of Natural Sciences" and its object "the promotion and study of the Natural Sciences, through the formation of a museum and library, the procurement of lectures and by such other means as shall be efficient and desirable for that purpose". At this meeting Hon. George W. Clinton was made president and for twenty years he was annually elected to that office. The others then chosen as the Society's first officers were–

1st Vice President . .	Rev. A. T. Chester, D. D.
2nd " " . .	Charles Winne, M. D.
Corresponding Secretary .	Samuel Slade.
Recording Secretary .	Theodore Howland.
Treasurer	Leon F. Harvey, M. D.
Librarian . . .	Richard K. Noye.

The nine curators first chosen, who, with the officers made up the Executive Board for management of the Society's affairs were, George E. Hayes, M. D., Prof. William S. Van Duzee, Hiram E. Tallmadge, Charles D. Marshall, Coleman T. Robinson, Charles C. F. Gay, M. D., Charles S. Farnham, David F. Day and Charles F. Wadsworth.

COLEMAN T. ROBINSON

Among the first charter members besides those named, were, Dr. C. W. Harvey, L. G. Sellstedt, O. H. Marshall, Charles Caryl Coleman, Solomon G. Haven, Thomas Farnham, Walter Clarke, David Gray, Ottomar Reinecke, Dr. James P. White, Augustus B. Fitch, George P. Putnam, John Howcutt, R. G. Snow, Eugene N. Robinson and the four young men already mentioned as having belonged to the earlier "Lyceum of Natural Science". Within a year about one hundred names were added to the local membership iucluding Henry A. Richmond, Augustus R. Grote, William H. Glenny and many beside who have proven steadfast friends to the Society.

These were days of first beginnings and many discouragements, but those charter members had the enthusiasm of youth and were not easily disheartened. The first lecturer was Professor Benjamin Silliman of New Haven who came for the evenings of February 19th, 20th and 21st, 1862. St. James' Hall, successor to the old Eagle Theater, had been burned on the 9th of January and presumably these lectures were given in the rooms first occupied by the Society on Erie St. in the building since used by Rogers Bowen and Locke and their successors. An old diary tells us that notwithstanding the hardest snow storm of the winter which raged on the first evening, quite a number of ladies were present and on the other evenings there was a larger and deeply interested audience.

About April 1, 1862 other rooms were secured over the New York and Erie Bank on West Seneca Street near Pearl. Here the Museum was fairly started in cases provided by Coleman T. Robinson. Augustus R. Grote contributed 600 specimens of Coleoptera collected in the State of New York and a like number of catalogued species of plants collected in the Rocky Mountains by Elihu Hull and J. P. Harlan.

Wm. W. Stewart was placed in charge of the Museum which grew so rapidly that soon the Seneca Street quarters were inadequate and more commodious rooms were taken in the third floor of the Jewett Building on Main St. opposite St. Paul's Church, where the collections might be better displayed.

On the 23rd of January 1863, the society was incorporated under the general Act of April 12, 1848 for the incorporation of scientific and other societies, the certificate being signed by Hon. George W. Clinton, Theodore Howland, Leon F. Harvey,

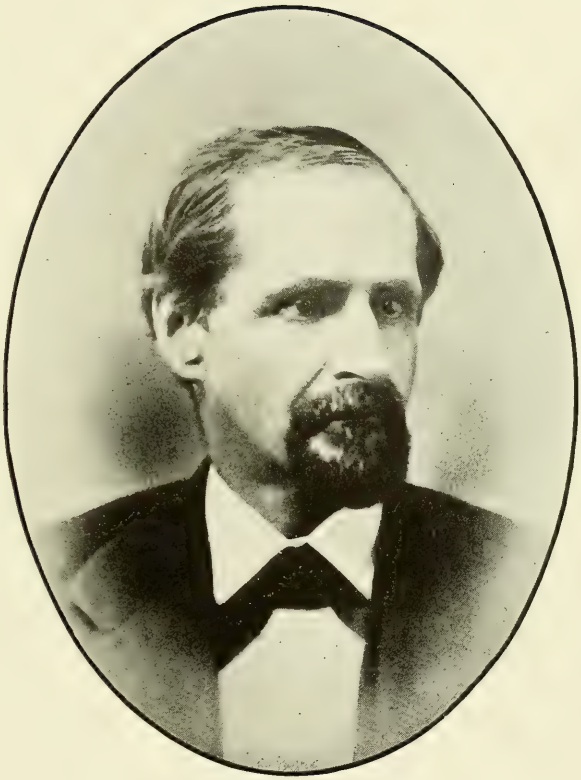
Coleman T. Robinson, David F. Day, Henry A. Richmond, Charles D. Marshall, H. E. Tallmadge, Dr. Charles D. F. Gay, William W. Stewart and Rev. Albert T. Chester.

Shortly thereafter came the most important change in the early history of the Society. The Young Men's Association of Buffalo, organized in 1836, had always occupied rented quarters and at this time their rooms and their fine library were located in the American Block. They had long felt the need of more ample accommodations, but the early days of the great Civil War were too full of trying vicissitudes to encourage plans which they had cherished for securing a building of their own. Public confidence was shaken, finances were unsettled and doubt and anxiety prevailed. With the opening of 1863 the skies seemed somewhat lighter, there was at least comparative prosperity and the preliminary negotiations for a building project were begun.

April 17, 1863 the Executive Committee of the Young Men's Association adopted a resolution authorizing their Building Committee to confer with the other societies of Buffalo of a kindred character with reference to constructing a building which would accommodate the several organizations.

Accordingly in response to their invitation, on the 25th of April a Committee of the Society of Natural Sciences consisting of Judge Clinton, its President, David F. Day and Coleman T. Robinson were appointed for conference and July 9th it was resolved: "that this Society hereby elects to participate in the erection and occupancy of the proposed building for the use of the Young Men's Association, the Grosvenor Library and other institutions of the City and to aid in the raising of the funds necessary for that purpose". These negotiations finally ended in the purchase from Mr. A. Brisbane of the property known as St. James' Hotel and St. James' Hall, at the corner of Main and Eagle streets, having a frontage of about 100 feet on Main St. and running through to Washington St. for which the sum of $112,000.00 was paid.

In soliciting the subscriptions for the purchase funds the members of the Society of Natural Sciences enlisted heartily and many of the generous subscriptions were given by them, the assurance being made that they should receive adequate accommodations for their needs.



CHARLES LINDEN

Director of the Museum

At this time subscriptions to the amount of $81,655.00 were secured, the property purchased, such alterations made as were necessary and January 10, 1865 the new buildings were occupied and the Society of Natural Sciences found itself housed under the same friendly roof with the Library, the Academy of Fine Arts and the Historical Society. The Society's modest collections were attractively displayed, a fine portrait of its President Hon. George W. Clinton, painted by L. G. Sellstedt was presented to adorn the walls by the artist, who was himself an active member, and by Coleman T. Robinson who showed still further his warm hearted interest by contributing his own collection of marine shells to form the nucleus of the large and valuable conchological exhibit now owned by the Society; an extensive and beautiful collection of minerals was given by Mr. Charles F. Wadsworth; new members came in, a larger interest was awakened, the collections grew more rapidly and despite its very limited financial resources, the scientific work accomplished from year to year amply justified the self-sacrificing efforts of its friends. Many will remember the tower over the St. James' Hall building and its beacon light when Judge Clinton worked late at night over his scientific studies.

During the Civil War many of those who were its founders volunteered in their country's service and as its members met there was often present with them the remembrance of hushed voices and the thought of unreturning feet, but when those years of storm and stress were over and days of peace once more returned, the Society met its first great loss in the death of Coleman T. Robinson who had been one of its first founders and from the beginning one of its most generous friends. An active business man, he was still deeply interested in scientific studies and especially devoted to entomology and conchology. At the time of his death he was engaged in the banking business in New York City. By his will he bequeathed his library, his microscope and his collections to the Society and also the sum of $10,000.00 as the beginning of a permanent endowment fund.

Accordingly on the 13th of February 1874 Dexter P. Rumsey, George E. Hayes and O. H. Marshall were appointed as Trustees of the Permanent Fund, then consisting of the amount of Mr. Robinson's bequest together with the sum of $500 accrued from ten life memberships. By slow degrees this

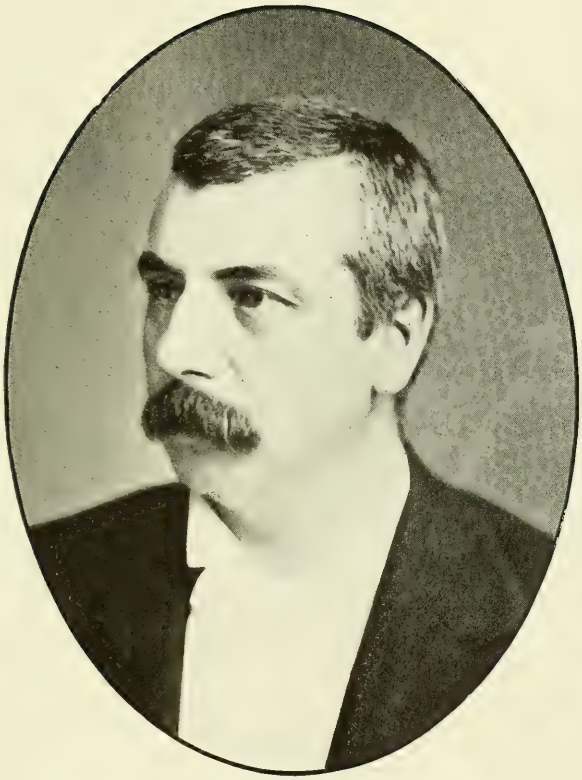
has grown so that there is now $24,827.50 in the hands of the trustees.

August 20, 1866 Charles Linden was appointed by the Society as its custodian, thus beginning a connection, the memory of which is cherished by all who knew him and marked by the beautiful bronze tablet with bas-relief portrait which occupies a prominent place on the walls of the Museum. Charles Linden was an extraordinary man. Born at Breslau, Germany, about 1831, educated first at the gymnasium there and then taught by his own efforts in the book of nature, both as a student and later as a teacher of science he was an enthusiast who had the rare gift of inspiring others.

Modest and unpretending in his ways, a seafaring life led him to the American lakes and to Buffalo where he found friends. Among these was Mr. Ottomar Reinecke, one of the Society s founders and himself a veteran naturalist, who quickly recognized his capacity for scientific work and brought him to the attention of the Society and its President Judge Clinton, so that his appointment soon followed. Three years later he was called to the Central High School as teacher of science and as such continued until his death February 3rd, 1888. For seven years however, he was the Custodian of the Society's collections and labored faithlully for their growth and for its welfare. It was through his efforts that the Bodemeier Collection of birds was brought from Europe and secured for the Society, the members of the Board of Managers subscribing at one of their meetings the necessary amount for its purchase. Each year as summer came the spirit of the explorer seized him and he wandered now to Florida, to Hayti, to Europe, to Brazil, to Labrador, to many strange and out of-the-way places whence he returned always richly laden with additions to the Museum collections. No man was ever more beloved by his pupils and his friends. Earnest, unselfish and helpful, the uplift of his example cannot be forgotten.

In 1901 a bronze tablet in memory of Charles Linden was placed upon the walls of the Central High School and in the appreciative address made on that occasion by Mr. Henry P. Emerson, Superintendent of Education, he said

"As a teacher Mr. Linden was remarkable for patient industry, for original methods of presenting truth, for his familiar and Socratic intercourse with his pupils, and for unswerving



AUGUSTUS R. GROTE

Director of the Museum

loyalty to the school he served. There was a freshness in his instruction as of nature herself. He was a Thoreauan in his love of the fields. Frequently he went outside of the matter given by ordinary writers and gave the pupils the valuable information he had gathered in his own travels. His enthusiasm, devoted, not to his own advancement, but to the improvement of mankind, exerted a salutary and quickening influence on his pupils.

"Another characteristic was his simplicity and modesty. Placing a high value upon results, he cared little for methods and ceremony. Regarding knowledge and truth as everything, he sought for them and made them known without bringing himself forward. He had literally no thought of self-advancement. He liked plainness and frankness; was genuine and transparent; incapable of insincerity or indirection.

"Mr. Linden was no slave to conventionality; possibly he cared too little for appearances. To some he seemed peculiar, but his peculiarities were doubtless exaggerated in the mouths and minds of those who did not understand him. At least they were not affectations, but like himself, perfectly spontaneous and sincere. He was an "interesting" man. What casual observers called eccentricities, those who know him better considered marks of a strong individuality. He was a "character" in the special meaning of that word– "one of those pieces of nature's workmanship which are malleable by no external influence of culture, society or circumstances". Such men always speak from within and echo no man's opinions. When such a man is a teacher he will be interesting and will strongly impress himself upon his classes, whatever deficiencies he may have; and this Mr. Linden did.

"His nature was thoughtful and philosophic. He was a constant reader, an original thinker upon the historical, scientific and social problems that attract thoughtful men. I was more than once surprised to find how familiar he was with some particular epoch of history. His comments and criticisms on men and events were interesting and generally just No man or woman without somewhat similar tastes could know him.

"He was not to be lightly gauged by outward manner or appearance. Those who did know him, as they now look back, treasure the recollection of his look, his figure, his voice, his abstracted air as he walked the streets, his hearty laugh at an amusing mistake in the class-room, his beaming face as he dis-

played some specimen, under the microscope, to his class assembled round him.

"His character was well epitomized in a few words spoken by Rev. Herbert G. Lord at his funeral: 'While other people were striving for money and to make a show in the world, this man had plodded through life in an unobtrusive way, content to learn, to know and teach'."

It was while Charles Linden was Custodian that the Field Club was organized as one of the branches of the Society's work. At the Society's meeting of May 3, 1872 a resolution was adopted requesting Mrs. George Hadley, Mrs. George L. Squier and Miss Mary L. Wilson to organize such a Club for the out of door study of the Natural Sciences and to arrange the days and places for field meetings, promising cordial aid for their work. In this Judge Clinton and Mr. David F. Day were deeply interested and on their field days Mr. Linden would accompany the club members, stirring up their enthusiasm by his own ardent interest, thus establishing a happy relationship which continued so long as he lived. This Club has now had an active existence of thirty-five years.

Among the early members of the Society had been Augustus R. Grote, who had however removed from Buffalo and had already become quite famous in scientific work, especially in connection with entomology. When Mr. Linden's duties as teacher became enlarged so that he could not give so much time as he desired to the Society's affairs, Mr. Grote was invited by the Executive Board by resolution of January 15, 1873, to return to Buffalo to become Librarian and director of the Museum. The invitation was accepted and Mr. Grote at once entered upon his duties. He was a naturalist of rare ability and of recognized reputation, young and enthusiastic, of sensitive nervous temperameut, a poet and musician as well as a devotee of science and the impetus which had been given to the Society's work and to the increase and proper arrangement of its scientific collections during the seven years of Charles Linden's custodianship was greatly furthered in the seven ensuing years during which Mr. Grote was the director.

By correspondence and exchange and by active field work the collections were rapidly increased. In his own favorite field of research his active efforts built up for the Society the famous collection of moths which bears his name and which at his earnest

GEORGE E. HAYES, M. D.

President Society of Natural Sciences

request was generously presented to him by vote of the Society when he left Buffalo in 1880. This collection was afterwards purchased by the British Museum which was eager to acquire it. In that custody it now remains, a memento of one part of the Buffalo Society's work in the advancement of Science. Some idea of its worth and of the thoroughness of Mr. Grote's scientific work may be shown in the fact that of the 1330 species in Grote's check list of North American Noctuidae, the collection included 1068 species and 2355 specimens of which 505 were type specimens.

These early days of Clinton and Day and Reinecke and Linden and Grote, and their associates had grown into busy active years of intellectual growth for the Society and under such guidance it had crept into the front rank among scientific organizations. At every meeting papers of great interest were read, covering the scientific subjects which were then enlisting the attention of the world.

In 1873 the Society began its publications, its first issue being Vol. I, Part I, comprising four important entomological papers by A. R. Grote. The four parts that make up the first volume were issued by March 1874, and contained no less than 16 scientific articles by Mr. Grote, with other valuable original papers by Peck, Willey, Morison, Scudder, Hartt, Rathbun, Harvey and Le Conte. From that time onward, the Society has continued its publications, embracing in them much important original material by distinguished scientific writers, thirty-four of the articles coming from the pen of A. R. Grote and including also the valuable botanical check lists compiled by David F. Day from personal observations made by Judge Clinton and himself, illustrated descriptions of the rare water lime fossils of this vicinity and many others of great worth. The Society's published bulletins are exchanged with Scientific Societies throughout the world, those of later years including the "Geology and Palaeontology of Eighteen Mile Creek" by A. W. Grabau, an exhaustive study, profusely illustrated and of high value, as is the later volume by the same author, a "Guide to the Geology and Palaeontology of Niagara Falls and Vicinity".

The Society of Natural Sciences was perhaps the first of Buffalo's institutions to bring an important convention within our city's gates.

The American Association for the Advancement of Science had been compelled by the vicissitudes of the Civil War to discontinue its meetings after that held at Newport, R. I., in 1860. In August 1866 at the invitation of the Buffalo Society it held its fifteenth meeting in this City, its sessions being held in St. James' Hall and in the rooms of the Young Men's Association in the American Block. It was welcomed to Buffalo by Judge Clinton in an address in which he claimed for our good city "a deep respect for literature, for art, for science, and a longing to make it as famous in letters as it is prosperous in commerce and manufactures". The meeting which lasted several days proved to be very interesting and once more the American Association was started on its forward career and when, ten years later, the Buffalo Society again extended its invitation to the great Association, it remembered the earlier kindness and accepted gratefully, holding its twenty-fifth meeting here during the week beginning August 23rd 1876. That was a famous meeting. The Centennial Exposition at Philadelphia had brought many savants from foreign countries who were present here in numbers and Thomas A. Huxley addressed the Association in the Common Council Chamber where the general meetings were held; the sectional meetings finding suitable rooms provided at the Central High School. There were reception parlors arranged at the Tifft House and evening sessions at St. James' Hall. Our good people flocked to these gatherings where they might hear from some of the greatest minds in the world. The effect of the meeting was all that could be desired. It left behind it an enthusiasm for study and perhaps for a time at least, many of our young men forgot their more material strivings in a new found eagerness for the things of the mind and the spirit. Again, in 1886, the American Association accepted our Society's invitation and met here at a time when the new building which it now occupies was being erected, and still once more in 1896 for the fourth time, the Association came here to hold its forty-fifth annual meeting and were welcomed by Dr. Roswell Park, then President of the Buffalo Society.

At all times the financial resources of the Society have been very limited and it is a matter of no small wonder that, notwithstanding this, so much has been accomplished in scientific work. The annual dues from members have never been

LUCIEN HOWE, M. D.

President Society of Natural Sciences

large in amount and oftentimes discouragement has stared us in the face, but some plan would be suggested for raising such funds as were absolutely necessary, such for example, as the Horticultural Fair held in 1866, to provide the money needed for entertaining the American Association; but most frequently when bankruptcy seemed imminent, a committee would start out with a subscription paper headed by themselves and public spirited men of Buffalo were not appealed to in vain.

From the outset the library and collections of its Museum had always been freely opened to the public; valuable scientific papers were read at each semi-monthly meeting of the Society and while still continuing these, in January 1876, the Society began its first public educational work by inaugurating its popular lecture courses which have been regularly continued each year since that time. For several years they were given in the Assembly room of the Central High School and in their earliest days the able members of the Society were the first lecturers. The initial course of ten lectures began with an excellent address by Judge Clinton enlightening his hearers as to the work of the Society and its possibilities. Then followed the familiar names of Grote and Linden, Larned and David Gray, Pitt and Kellicott, Milburn and Prof. William B. Wright and others, repeated and added to from year to year until there was sufficient money available to bring some distinguished savant whose name might add lustre to our native gold.

The effort to interest the people was timely and soon showed results, for in 1878, for the first time, an attempt was made to introduce into the city grammar schools elementary scientific studies, and it is recorded on the minutes of the Society that at a meeting held April 11, 1879 a resolution was adopted heartily commending the experiment and urging the school authorities to continue the effort to instruct the children in the elementary facts of the natural Sciences.

April 9, 1880, to the great regret of his many friends, Mr. Grote tendered his resignation as Director of the Buffalo Society of Natural Sciences which was reluctantly accepted. His scientific work had been and continued to be of the highest value. To the first three volumes of the Society's publications his contributed articles included his descriptions of North American Moths and his check list of the Noctuidae of this country.

While here he also edited the volume (in twelve numbers) of the North American Entomologist, published by Reinecke, Zesch and Baltz of Buffalo, a creditable publication, as among its contributors were many distinguished students of entomology.

After leaving Buffalo he took up his residence abroad, living at Bremen and later at Hildesheim in Hanover where at the time of his death September 12, 1903, he was director of the Roemer Museum. The American Entomologist (November 1903) says of him "He was an authority on the entomological fauna of Western New York State, particularly the region about Buffalo, but will be best remembered for his systematic work on North American Noctuidae. He described numerous species of Lepidoptera, aggregating over a thousand. His work made a great impression on our literature of the subject and was painstaking and accurate. His descriptions are good and his species well known. He will undoubtedly, be classed as one of the greatest students of American Lepidopterology. His catalogues were most valuable and universally used."

A still greater loss befell the Society when, on the 13th day of January, 1882, Hon. George W. Clinton, who had been its President for more than twenty years tendered his resignation, as he was about to take up his residence in Albany to enter the service of the State as the editor of the Clinton Papers. In all these years of faithful loving service, the Buffalo Society of Natural Sciences had become to him as his own child and he had become endeared to its members with a peculiar affection. The success of the Society has been largely due to his spirit and his labors. One who remembers those days writes of them, "I look backward and I see a long table in the assembly room and a kind looking, gaunt old man, with fine rugged features and pale blue eyes is resting his hands upon the table before him and talking to a lot of attentive disciples. He has presided that day over the Superior Court, now, like him, alas, no more, and has ruled upon exceptions and allowed or disallowed them in some important law suit, and now he has turned his back upon the dry dust of the law and is talking to his auditors about the fauna and flora of this end of the State, and all pay reverence to the Chief Judge who is deep in philosophy and nature-study and loves things as they are and not as the wills and caprices and imaginations of men would make them out to be."

LEON F. HARVEY, M. D.

President Society of Natural Sciences

The great Clinton Herbarium which with the enormous labor of years he built up for this Society and which includes more than 24000 exhibits, is a testimony to the unselfish satisfaction which he ever took in his devotion to its interests. Its indebtedness to Judge Clinton cannot be measured by words. The whole community felt the influence of his spirit. As his friend, Hon. James O. Putnam once said, "He was our universal educator. Not to speak of his eminent professional career, he has taught us the sweet humanities and that unbought grace of life, which are the highest and purest charm. Nature's own child, he has unfolded to us her mysteries, as she has revealed them to him, from tree and shrub and flower and her myriad schools of life. For him, nature unveiled her face and filled his ear with music and his soul with all pervading harmonies."

Judge Clinton was a man of deeply reverent feeling. His was no inconoclastic spirit that could rejoice in breaking down rather than in building up. A true scientist, he had no fears for the safety of a demonstrated proposition and was ever glad to welcome investigation and growth and new knowledge. "True it is" said he in one of his addresses, "that no one can verify all facts and we must take many things on trust; but in investigation of any it is dangerous to be wedded to a theory." So unproven conjecture never appealed to him and his convictions were based upon fact rather than upon hypothesis. He was simple, straightforward and kindly in his ways and in his speech and by his gentleness compelled the affection of all who knew him. Men loved him and his presence was a blessing.

His sudden death which occured at Albany three years later (September 7, 1885) seemed in keeping with his life. Wandering through the Rural Cemetery in the autumn afternoon, his life suddenly ended and he was found with some flowers in his hand which were buried with him. In the words of George William Curtis before the Board of Regents of which Judge Clinton was Vice Chancellor, "Nature seemed to have reclaimed the old man, whose heart the love of her had kept as warm and unwasted as a child's. Like Enoch, in that tranquil, beneficent, blameless life, he walked with God, and God took him."

He was succeeded in the Presidency of the Society of Natural Sciences by Dr. George E. Hayes who was elected February 18, 1882, though he held the office for a few months

only as his death occured on the 5th of May in that year. He too had been one of the Society's founders in 1861, as he had been in 1836 one of the organizers of the Young Men's Association and one of its first Presidents. From the beginning he had been a very active member of our executive board and always most liberal in contributing to its support. Although quiet and retiring in his ways he always participated in the interesting discussions which followed the scientific papers read at the Society's meetings and two of his own lectures before its members, those upon the "Geology of Buffalo" and upon the "Origin of Life" have been published in pamphlet form as well as in the memorial volume issued after his death. His last public utterance was his inaugural address delivered February 17, 1882, upon taking office as President.

He was always profoundly impressed with the educational work which the Society attempted and with its possibilities and after his death it was found that under the provisions of his will, one third of the income of his estate was to be reserved as an accumulative fund until the death of his widow when the whole estate should be divided equally between his daughter and the Buffalo Society of Natural Sciences as an endowment for a free school of Natural Science "or for the purpose of advancing the interests of Natural Science in the City of Buffalo." There could be no finer gift to the cause of scientific education and no finer tribute to the unselfish devotion of the giver to that cause than is this noble benefaction.

At the time of Dr. Hayes' death, Dr. Lucien Howe, the First Vice-President became President and had the honor of reelection February 16, 1883, to by followed in 1884 by Mr. David F. Day, in 1885 by Dr. Leon F. Harvey and in 1886 by Professor D. S. Kellicott who held the office for three years. Professor Kellicott had long been an interested member of the Society and active in scientific investigation, contributing frequent articles to the various science journals, always illustrative of original work. In charge of the science studies at the Buffalo State Normal School it was mainly by his endeavors that the science building was added to its equipment. When he resigned in 1888 to become Professor of Zoology and Comparative Anatomy at the Ohio State University, Columbus, Ohio, his departure was deeply regretted by all who knew and appreciated the valuable service he had rendered to Buffalo.

Prof. DAVID S. KELLICOTT

President Society of Natural Sciences

For twenty two years the Young Men's Association Library, the Society of Natural Sciences, the Fine Arts Academy and the Historical Society occupied the old St. James' Hotel and Hall property at the corner of Main and Eagle Streets, but in the later years when the library and the several collections had grown to large and valuable proportions, there had developed a strongly increasing desire to see these possessions more safely housed and more adequately provided for in a fire proof building. In the autumn of 1882 steps were taken by nine public spirited citizens of Buffalo to secure from the Board of Supervisors the site once occupied by the old county buildings at the corner of Washington and Clinton Streets, which had been vacated in 1876. April 18, 1883 a meeting of prominent men was held at the residence of Mr. Sherman S. Jewett when a plan was submitted for erecting on that site a suitable fire proof building for the joint occupancy of the Library and its three sister societies. This plan met with such hearty approval that the undertaking was at once entered upon with vigor. At the meeting of the Society of Natural Sciences held April 24, 1883, a resolution was adopted "That the Buffalo Society of Natural Sciences most cordially approves of the project as one which will materially aid in forwarding the cause of education in this city. That a committee of five be appointed from this society to advise with and assist other committees appointed for this purpose. That we earnestly entreat all friends of our Society to forward this work in every way in their power, feeling that now is the time to place these institutions in a position which will make them an honor to the city, and will materially increase their powers of usefulness."

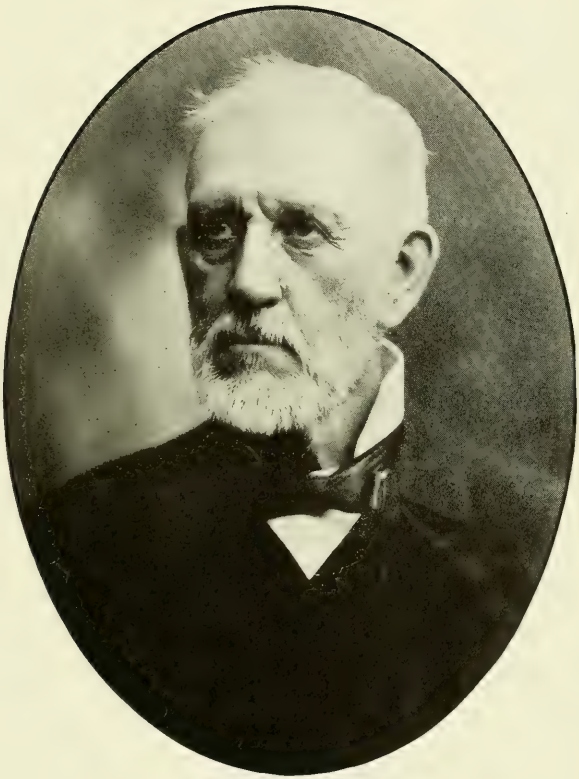
It was necessary that in addition to the funds to be obtained by a loan upon the Main and Eagle Street property, an additional $100,000.00 should be raised by subscription and in the campaign which now followed to secure this sum the members of the Society of Natural Sciences were earnest and actively vigorous in generous assistance. When the final appeal was made to the public at large, the result was a happy surprise to all concerned. A building fund suscription of $117,000.00 was secured, after much mutual conference plans were prepared and adopted and in January 1885, the contracts for the principal work were let. The noble structure which was to become not only an architectural ornament but a powerful moral force as well in this city

slowly moved onward toward completion, and on the 7th of February, 1887 was formally opened to the public with fitting inaugural exercises. The venerable and beloved Bishop of Western New York, Rt. Rev. Arthur Cleveland Coxe, D. D. offered the dedicatory prayer closing with this solemn dedication.

"In the name of God, Amen: We pronounce this house opened and devoted to the good of human minds and spirits: and may the blessing of the Father and of the Son and of the Holy Ghost rest upon it, henceforth and forevermore. Amen."

Following the inaugural address of Mr. Jewett M. Richmond, President of the Young Men's Association and that of Hon. Sherman S. Rogers of the Fine Arts Academy, Prof. David S. Kellicott, President of the Society of Natural Sciences spoke on its behalf, calling public attention to what the Society had accomplished in the first quarter of a century of its existence then just ended and followed his brief historical sketch by a consideration of some of the reasons, so far as the public is concerned, why it and its kindred societies exist, claiming justly that they are educators in the broadest sense and their purpose to encourage investigation, to discover and make known the facts and laws of Nature, that knowledge which becomes of more and higher importance as society advances, calling attention to the fact that here its discussions are public, its valuable collections and its large scientific library always freely open for profitable study, inviting the good people of Buffalo to a more thorough acquaintance and a deeper general interest in its work, ending with the words "The Society is your own, one of your educators, know it, respect it, cherish it."

There had been no small labor in moving the collections and their cases from the old building into the beautiful home now provided for them, but when this had been accomplished and the collections again arranged and displayed it seemed as if our public spirited men and women had indeed proved themselves to be that which Judge Clinton with prophetic eye had claimed for them in his welcoming address to the American Association in 1866 and had made good that "respect for literature, for art and for science" which he asserted as their attribute at that time. When the collections had been placed the rooms were formally inaugurated on the evening of June 14, 1887, when after proper words of welcome by the President Prof. Kellicott, an able address was delivered by Prof. Edward S.



Hon. DAVID F. DAY

President Society of Natural Sciences

Morse of Salem, Mass. who came at the generous invitation of Mr. Henry A. Richmond to speak on the purpose and value of Scientific Societies.

And so the Society found itself fairly embarked upon the second quarter of its useful life comfortably and safely housed and with renewed vitality. It seemed indeed an especial good fortune that the Young Men's Library and the collections of the three sister organizations were thus secured in safety, for on the 18th day of March, 1887, the building which they had occupied for so many years, regarding which its occupants had grown so fearful and which had now become "The Richmond" hotel, was destroyed by fire and the terrible loss of life which then occured cast a gloomy shadow over the whole community and all its rejoicings. It seemed a singular fact that this was the Library's second close escape from destruction, for the American block which it had occupied for several years was burned January 25th 1865, just fifteen days after the removal to St. James' Hall.

The rooms provided for the Society of Natural Sciences and now opened by it for free public use, were in the basement of the new building and included an assembly room for public lectures and the Society meetings. Other rooms were devoted to geology, mineralogy, botany and the various exhibits of scientific possessions, one room being given to the remarkable collection of fossils from the water lime group near Buffalo presented by Mr. Lewis J. Bennett, so long the warm and generous friend of the Society, comprising 323 valuable specimens, and unique in the large number and variety of specimens of the Eurypterids of which many are types, making it the most complete and valuable collection of water lime fossils in existance. For sixteen years these basement rooms were the Society's home and as collections grew and the library increased in size it became impossible to find room and valuable exhibits were of necessity stored away until in 1902 the Buffalo Historical Society which had occupied the upper floor of the Library building found a new home in the beautiful marble structure which the State of New York erected in Delaware Park for the Pan-American Exposition. With their departure the Society of Natural Sciences was kindly permitted to occupy the upper floor as well as the basement, to the great relief of all concerned.

A new and more commodius lecture room was thus provided as well as better rooms for the Society's scientific library of about 5000 volumes, for the conchological exhibit and for the excellent archaeological collection of some 5500 specimens. This latter collection had grown from small beginnings to assume a representative character, gaining greatly by the generosity of Mr. Fred. S. Dellenbaugh, Dr. Ernest Wende, Mr. Frederick Houghton, Mr. D. M. Silver and others, by the acquisition of the unique collection of Chiriqui pottery, purchased for the Society by Mr. David F. Day, Dr. W. C. Barrett and Dr. Lee H. Smith, and the Riggs Collection of Mound Builder pottery obtained in 1891. At the close of the Pan-American Exposition in 1901 all of the African Village archaeological exhibits were secured for the Society by Mr. Edgar B. Stevens, Dr. Lee H. Smith and Mr. Robert R. Hefford.

The exhibit of mammals includes the finest group of the American Bison ever mounted, a superb group of Rocky Mountain Goats and a large number of other groups, scarcely less noteworthy All of these beautiful groups show the great skill of Mr. Herman Grieb the well known taxidermist who has been for many years a generous and faithful friend of the Society and its fellow worker. The cases for these groups as well as the greater portion of those used for the Society's collections have been made by Mr. H. W. Kruse of this city and show his always able workmanship.

The Ward collection of casts of fossil remains is of great value to students. The geological and the mineralogical collections are very comprehensive in scope and are being constantly increased. A recent accession is a splendid meteorite from the celebrated Cañon Diablo, presented by Mr. Andrew Langdon in 1906. The famous Clinton Herbarium has been already mentioned as also the fine Bodemeier Collection of European Birds and in addition to this the collection of New York State birds is practically complete. The conchological collection includes a considerable number of types described and presented by Dr. Isaac Lea, as well as a complete collection of local species. The Kellicott collection of types of fresh water sponges is unique of its kind. The valuable reference Library of scientific publications contains over 5000 bound volumes and is being rapidly increased by the Society's exchanges.

HENRY P. EMERSON

President Society of Natural Sciences

After the resignation of Mr. Grote as Director of the Museum, Charles Linden again assumed that responsibility and under his supervision Dr. Julius Pohlman acted as custodian and librarian until May 1890 when his resignation was accepted. Dr. W. C. Barrett was then made Director of the Museum and Miss Amanda M. Crawford was employed to arrange and classify some of the collections. February 11, 1892 Mr. Frederick K. Mixer was appointed Director and had charge of the Society's collections for seven years.

Mr. Mixer was a close and careful student of Geology and Mineralogy and classes were organized by him for science work and successfully carried on under his management. When he resigned, October 6, 1899, Miss Elizabeth J. Letson, who had for several years been engaged in special work for the Society was made Director of the Museum, an office which she still holds (1907) after a faithful service of fifteen years since she first entered the Society's employment. In 1905 the State Museum at Albany published a check list of the Mollusca of New York prepared by Miss Letson, who received the honorary degree of Sc. D. from Alfred University in 1906, and in recognition of its worth, she has now (1907) been commissioned to prepare a monograph upon the Land and Fresh Water Shells of New York State to be freely illustrated with colored plates and published by the State.

May 28, 1889, Hon. David F. Day was elected President of the Society to succeed Professor Kellicott and held that office for three years. One of its original founders, the close friend and associate of Judge Clinton in their favorite study of botany in which both were famous, Mr. Day was from its first beginnings until he died, August 21st, 1900, a firm and steadfast friend to the Society of Natural Sciences and devoted to its highest interests. Deeply concerned in all Natural Science work, he was especially interested in studying the flora of Western New York and his check lists of the plants of Buffalo and its vicinity, published in the Society's bulletins are considered as authoritative and complete. Conservative in temperament, deliberate and thoughtful in action and speech, his conclusions were well grounded, logical and always worthy of consideration and acceptance by his fellow workers in the field of science, and in this Society which he had cherished and served so long, his loss was and is most deeply felt.

In 1892 Mr. Henry P. Emerson, Superintendent of Public Schools became President and was succeeded in 1893 by Mr. William H. Glenny who did much to further the successful work of the Society. From 1896 to 1899 Dr. Roswell Park was President, followed in that year by Dr. Lee H. Smith, always most actively concerned in the Society's welfare. For four years Dr. Smith was annually re-elected as President but in 1903 was succeeded by Hon. T. Guilford Smith, LL. D. who still continues in that office.

Himself a Regent of the University of the State of New York, and deeply interested in the cause of public education, chairman of the Museum Committee in charge of the scientific work of the State since his election in 1890, and a member as well of many institutional boards and public societies, Mr. Smith has done much to enlarge the scope of the Society's connections and correspondence with other similar organizations and to increase the extent of its public usefulness.

The Field Club, which began in 1872 was the earliest affiliated branch of the Society, but as the years went on other branches were organized and gradually the Microscopical Club, the Archaeological Club, the Agassiz Association, the Entomological Section, the Conchological Section and the Electrical Society came into existence as working parts of the parent Society which furnished the gathering place for their meetings and the generous use of its collections and apparatus for their studies. A constant disposition has been shown to co-operate with any organization that has in view scientific research and public instruction.

Beginning with such names as those of Benjamin Silliman and Louis Agassiz in 1862, the Society of Natural Sciences has brought many famous men to Buffalo during the forty-six years of its existence. Its lecture rooms have been crowded, often to repletion, by the good people of our city eager to hear the great men of science who have come, upon the Society's invitation, to honor us with their presence and charm us by their utterance.

In addition to the first natural function of the Society, the stimulation and encouragement of original research in the various departments of Natural Science, — endeavers in which it has been eminently successful, — its controlling purpose has always been to further the educational work of Buffalo by every

WILLIAM H. GLENNY

President Society of Natural Sciences

means in its power. To this end for nearly half a century its Museum and library has been opened to the people for their free use, and its popular lecture courses have been given each winter, upon scientific subjects which could interest the public and especially awaken the enthusiasm of our high school pupils and those of the upper grades in our grammar schools.

Every facility for study for these and for all students has at all times been freely placed at their command. The Society has always realized the important position which a great scientific museum should occupy in the educational system of our city and has always opened its doors freely to the public. The immediate result of the resolution adopted at the meeting of April 11, 1879, encouraging the tentative effort of the Department of Public Instruction to introduce elementary science work in the Buffalo grammar schools, was to bring the science teachers with their classes to the Society's rooms where the various collections were displayed for their convenience. Travelling collections of scientific exhibits were prepared and loaned to the schools. Then acting upon a plan first conceived by Prof. Frederick Houghton and Dr. Lee H. Smith, special lectures upon familiar topics of general interest for the schools such as "Bees", "Birds", and "Insects", were arranged and proved successful and from these beginnings our present educational work has been evolved. A projection apparatus was added to the Society's equipment and employed to illustrate talks given by school principals or class teachers.

Finally in 1905, by arrangement with the Department of Public Instruction, the Society's rooms were placed at the disposal of the Superintendent of Education for the establishment of regular hours of instruction by illustrated lectures to the children of the public schools, these lectures becoming an integral part of the school requirements, the attendance of the grammar grade classes being made compulsory. The services of Dr. Carlos E. Cummings, as lecturer were secured by the Society at its own expense and these courses of instruction in elementary science as given by the Society have now been carried on for three years with most satisfactory results. During the last year ending June, 1907, 190 lectures were given to a total attendance of 19731 public school children, the subjects being "Bees", "Birds", "Tropical Products", "Physiology", and "Coal and Iron". An exceedingly interesting and detailed

account of these lectures written by Dr. Cummings was given in a bulletin published by the Society in 1906. The Society owns a valuable and most interesting series of nearly 2000 lantern slides which it has prepared for this most important branch of its work. It has been the pioneer among the Societies of Natural Science in establishing in this way a direct educational relationship to the public school system of a great city. Its success has awakened a wide spread interest throughout the United States and Canada: many letters of inquiry regarding our methods are constantly being received and other Scientific Societies in leading cities are already seeking to follow the example set them here. During the summer of 1907 Dr. Cummings has been invited by Dr. George E. Vincent of the Chautauqua assembly to deliver his lectures there, with an advanced course for Science teachers attending that summer school.

On the 13th of March, 1903, Mr. Dexter P. Rumsey and the heirs of Bronson C. Rumsey of Buffalo, conveyed as a gift to the Buffalo Society of Natural Sciences a plot of land having a frontage of 150 feet on Elmwood Avenue lying southward from the southerly boundary of Delaware Park with a depth of 280 feet to a proposed street that will be parallel to Elmwood Avenue. This beautiful property, valued at about $30000.00 was generously given as the site for a building suited to the Society's purposes. Plans for such a building have been prepared by Messrs. Green and Wicks and it is greatly hoped that in the near future the necessary means may be provided for its erection as a permanent home for the Museum, with the proper lecture rooms and laboratories for its educational work.

It is now forty-six years since the Buffalo Society of Natural Sciences was first organized. Of the one hundred and twenty nine members who joined in that organization but sixteen are still living, but, as the years have slipped by, the places of those who have passed away have been taken by others who have labored with zeal to maintain the high ideal of service which has ever characterized the Society's endeavors. It has grown from the smallest beginnings to the recognized position of influence which it occupies today. It is an educational factor of no small importance in the school system of our great city and has become a teacher to other scientific

ROSWELL PARK, M. D.

President Society of Natural Sciences

societies elsewhere who are glad to profit by our successful experience.

From the beginning the Society has had to contend with the adverse conditions of poverty. Its limited financial resources have often forbidden undertakings of great promise. Nevertheless, thanks to its faithful friends who have saved it from disaster, it has been able to maintain a highly honorable existence and to show a steady growth.

It is expected that the Hayes bequest will greatly assist in its educational work, and it is hoped that with this prospect of usefulness in sight, its membership may now be largely increased and that it may be enabled to undertake the duties that clearly lie before it with vigor and with the knowledge that its efforts will be widely acknowledged and generously sustained.

HENRY R. HOWLAND.

July 1, 1907.

The Trustees of the Permanent Fund

As has been briefly stated in the foregoing sketch, on the 13th of February 1874, Dexter P. Rumsey, Dr. George E. Hayes and O. H. Marshall were appointed as Trustees of the Permanent Fund which had its first beginnings in the generous legacy of Coleman T. Robinson. Upon their organization Mr. Charles D. Marshall was made the Treasurer of the Fund and through all the changes that have since occurred he has continued to hold that responsible office.

Any record of the Society's history would be incomplete that failed to pay a tribute of grateful appreciation to Mr. Marshall for the unselfish and devoted service to the Society's best interests which he has so freely given for more than thirty-three years. The watchful care of its investments has taken up no small portion of his time and attention, the burden naturally falling upon his shoulders. One of the original organizers of the Society in 1861, as well as one of its incorporators in 1863 his interest in its welfare has been unfailing and that interest has had its practical manifestation in the painstaking service of so many years. In this the Society has indeed been fortunate. Those who with Mr. Charles D. Marshall are now Trustees of the Permanent Fund are, Mr. William H. Glenny, Mr. Robert R. Hefford and Mr. H. H. Littell.

H. R. Howland.

LEE H. SMITH, M. D.

President Society of Natural Sciences

ANNUAL MEETING

of the

Buffalo Society of Natural Sciences

May 17th, 1907

At the Annual meeting of the Buffalo Society of Natural Sciences held May 17, 1907 at which Hon. T. Guilford Smith, LL. D., President of the Society, presided, the President's address traced the growth and development of the Society from its small beginnings and dwelt upon the important educational work which it is now doing, the value of that work to this city in its co-operation with the Department of Public Instruction, in its free lecture courses and in its valuable scientific collections which are at all times open to the public. The recent Bulletin reviewing the work which the Society has done in co-operation with the Public Schools, has awakened a wide spread interest and other Cities than our own are following our example. In this great work we have taken the lead and it is planned not only to continue it but to extend the scope of its usefulness.

The reports of officers and committees were then submitted.

EDUCATIONAL REPORT.

The Report of the Committee on Education, in the absence of the chairman, was made by Dr. Carlos E. Cummings who stated that his work during the year covered 190 lectures given by him at the Society's rooms to the children of the Buffalo Public Schools, as shown in the following schedule.

No.	Subject	Grade	Date begun		Date ended		No. of Lectures	Attendance
I	Bees	7	May	14	June	1	24	2663

SUMMER VACATION.

II	Birds	7	Nov.	20	Feb.	5	47	3208
III	Physiology	9	Dec.	14	Jan.	11	13	515
IV	Tropical Products	6	Feb.	5	March	8	34	4862
V	Coal and Iron	5	March	13	April	18	30	3914
VI	Physiology	9	April	29	June	14	23	1477
VII	Bees	7	May	13	June	14	19	3092

Total number of lectures 190 Total attendance 19,731

All of these lectures are illustrated by the materials in our own Museum. In series I and VII a full hive with the bees at work is used, as well as an empty hive showing the frames, bee-cells, etc. and a series of lantern slides illustrating the principal features of bee life as indicated by John Burrough's stories about bees, used in the schools as a reader.

In series II is used the fine set of lantern slides owned by the Society, illustrating birds and their homes.

The lectures on Physiology, series III and VI were tried for the first time last year and have proven to be the most popular in our courses. The State Regents require a certain amount of practical experimental work before the classes and as the Public Schools do not have adequate facilities for such work, the ninth grade classes have come to us for it. All the experiments required are given before these classes, the circulation of the blood in the tissues is demonstrated and when desired by the teacher, photo-micrographs illustrating normal histology are thrown upon the screen and explained to the pupils. The skeleton purchased last year has also been in daily use.

In series IV for the 6th grade the lectures are illustrated by the specimens of tropical fruits displayed in the cases and by numerous lantern slides of scenes in Jamaica and Mexico.

The lectures on Coal and Iron (Series V) failed somewhat of their purpose as a portion of these fifth grade pupils had not begun the study of United States Geography.

The Schedules for these lectures are prepared by the Department of Public Instruction and placed in the hands of the

Hon. T. GUILFORD SMITH, LL. D.

President Society of Natural Sciences

school principals and the spirit of hearty cooperation shown by principals and teachers alike has been most encouraging.

RECORDING SECRETARYS REPORT.

The Recording Secretary, Dr. Carlos E. Cummings, reported that as a delegate of the Society he attended the Tenth International Geologic Congress at Mexico City in August, 1906, visiting with other delegates the cities of Puebla, Oaxaca and Tehuacan, from which side trips were made to the interesting ruins of Mitla and the cactus country of Zapotitlan. During the sessions of the Congress which were held at the National Institute of Geology, trips were made to Cuernavaca, Pachuca and to the Pyramids of Teotehuacan. At the close of the Congress, he visited the coast, passing through Jalapa, Vera Cruz and Orizaba, following this by a thirty days' journey from Mexico City northwest to the American frontier and returning to the Capital. He was thus enabled to secure for the Society a large amount of exhibition material, illustrating the mineral resources of Mexico and also about a thousand photographic negatives from which about 700 lantern slides have been made for lecture work. As will be seen Dr. Cummings delivered four of the lectures in the general course, of which three were descriptive of Mexico, and one of the Island of Jamaica.

He also reported his trip to the Lake Superior Copper region in June 1906 when he visited the Calumet properties and other mines in the vicinity of Houghton, Michigan, securing many valuable exhibits of copper ores and interesting photographs.

As a delegate of the Society he attended the meeting of the American Association for the Advancement of Science at New York in December 1906, also representing the Society at the Memorial Services held at Wyoming, N. Y. in honor of the late Professor Henry A. Ward and at his funeral.

He reported that in addition to his lecture work for the schools he had added largely to our collection of lantern slides, which now numbers nearly 2000 pictures including the Mexican slides, about 300 referring to Jamaica, the remainder illustrating subjects of Nature study. Of these the series illustrating birds and their nests is especially fine and the Society is greatly

indebted to Mr. James Savage for lending his splendid negatives of bird homes.

During the year several delegations of British school teachers visiting this country to inspect American methods of teaching, have been received at our rooms where they have inspected our collections, listened to lectures and have been greatly interested in our own methods of conducting educational work.

DIRECTOR OF THE MUSEUM.

The Director of the Museum, Miss Elizabeth J. Letson, reported the numerous donations to the Museum which have been made by generous friends during the year, including the valuable Meteorite from Cañon Diablo, Arizona, presented by Mr. Andrew Langdon, and the portrait of the late Prof. Henry A. Ward, given by his son.

As in past years the teachers of our public schools have made continuous use of our various collections and the loan or travelling collections furnished to all of the public schools have included specimens from nearly every department of our Museum. There is a constant demand for material for special nature work from the schools and from private teachers. Some of our collections, as for example, our birds, show the effect of this constant usage and may, ere long, require to be replaced.

The collection of birds' eggs has been catalogued during the year by the card system as used in libraries, there being also an accession register. The work of labelling and cataloguing the Conchological Collection is now in hand, the catalogue being about half finished.

Our inventory shows that the Museum contains 63,052 specimens in all its departments of which but 7,512 thus far have been entered in our new card system catalogue. It seems important that this catalogue work should be pushed forward as rapidly as our means will permit.

The Director of the Museum represented the Society in June 1906 at the Ithaca Meeting of the American Association for the Advancement of Science and again at the December Meeting in New York City. At this time all of the Departments of Natural History and Ethnology united in an exhibition given at the New York Museum of Natural History for the

purpose of illustrating recent advances in the study of the natural sciences. By invitation of the Association our Society sent a collection of specimens from the water lime which attracted much attention in the exhibit of the Geologic section.

In September 1906 the Director of the Museum attended the International Congress of Americanists at Quebec and in April 1907, the Meeting of the American Oriental Society at Philadelphia. At the request of the Society she has also visited Chicago and Detroit in connection with her studies of certain groups of New York mollusks. In June 1906 the Director received the honorary degree of Doctor of Science from Alfred University.

TREASURER'S REPORT.

The Treasurer, Mr. Charles R. Wilson, reported as follows:

1906	RECEIPTS.	
May 11.	Balance on hand	$ 178.69
	Income from Permanent Fund	1102.27
	City of Buffalo	1000.00
	Membership Dues	713.00
	From Estate of Dr. George E. Hayes, decd., Amount due up to Nov. 21, 1906	55.83
	Borrowed from Manfrs. & Trad. Nat. Bank	2000.00
	Borrowed from Est. of G. E. Hayes, decd	1500.00
1907	Interest on Bank account	2.53
May 17.	Total amount of receipts	$ 6552.32

DISBURSEMENTS.

Salaries	$ 2645.00	
Lectures expenses	476.33	
Society rooms expenses	480.00	
Travelling expenses	430.75	
Museum supplies, material and repairs	329.40	
Stationery and Printing	438.89	
Gas and Electric lighting	170 40	
Insurance	183.60	
Postage	33.00	
Miscellaneous Expenses	104.30	
Commissions	92.20	
Estate of Geo. E. Hayes, dec'd, Int. on note	50.00	
Manfrs. & Traders Nat. Bank, Int.	370.87	
Chas. H. Ward, work on Inventory	150.00	5954.74
1907 May 17. Balance on hand		$ 597.58

PERMANENT FUND.

The Commissioners of the Permanent Fund, by Chas. D. Marshall, Treasurer, reported that May 17, 1907 the principal of the fund aggregated $24,827.50, of which all but $2677.50 is invested in bonds and mortgages and that the amount of interest moneys received during the year was $1102.27 which has been turned over to the Treasurer of the Society.

ROOMS COMMITTEE.

Mr. H. R. Howland, Chairman of the Rooms Committee reported that during the year just ended a very careful inventory had been made, begun by Mr. Chas. H. Ward of Rochester who had been employed for the purpose and completed by our staff showing the number of specimens in the Society's Colleetions and their value as follows:

Section		No of Specimens	Value	
A	Ornithology	1610	$ 4729.80	
B	Conchology	11481	1906.38	
C	Ethnology and Archaeology	5502	22457.85	
D	Mineralogy	1976	3437.50	
E	Geology and Paleontology	5210	7463.40	
F	Mammals	28	9546.25	
G	Ichthyology	242	540.50	
H	Herpetology	123	454.00	
I	Entomology	5347	1304.75	
K	Botany	24084	6075.00	
L	Economics Collections	7240	2690.55	
M	Osteology	110	636.25	
N	Miscellaneous	99	436.00	
	Total Numbers	63052	Value, $61678.23	$61678.23
Furniture, Cases, Portraits and Apparatus				7322.91
Library,	Bound volumes	4620	Value, $ 8372.00	
	Unbound "	300	300.00	
	Pamphlets	1245	124.00	
	Maps	22	22.00	
	Bulletins on hand	5962	Est. Cost, 4000.00	12951.50
	Total Number	12149	Value $16951.50	$81952.64

By this it will be seen that the Society's Collections with its Library and its furniture, cases, portraits and apparatus reach a total value of.....	$ 81,952.64
To this add:	
Present amount of Permanent Fund.....	24,827.50
Estimated value of land donated by the Rumsey Estate for permanent location.....	30,000.00
Giving as our total assets at this date.....	$ 136,780.14

Upon its possessions now in the Public Library Building the Society is carrying insurance amounting to $34,000.00.

During the past year a new system of electric lights has been installed in the lecture room, with a separate connection for the stereopticon by means of which the room can be instantly darkened or re-lighted without inconvenience to the audience. This system has been inspected by the Board of Fire Underwriters and pronounced satisfactory.

A system of electric lights has been installed in the dark room and other facilities arranged including several new sinks, an electric fan, etc. making it a model room for its purposes.

During the year, the bronze tablet with bas-relief portrait, honoring the memory of Charles Linden, has been placed on the wall of the Lecture Hall.

LECTURE COMMITTEE.

Mr. Howland as chairman of the Lecture Committee reported that during the year eighteen evening lectures have been delivered at which there has been a total attendance of about 3600 persons.

The names of the lecturers and their subjects are as follows:

Nov. 2, 1906. Mr. Andrew Langdon,
"The Fall of a Celestial Wanderer". Illustrated.

Nov. 19, 1906. Dr. Carlos E. Cummings,
"Jamaica". Illustrated.

Nov. 23, 1906. Prof. P. F. Piper and Richard F. Morgan,
"Cobalt and Vicinity". Illustrated.

Dec. 14, 1906. Dr. Alice Bennett,
"Every Day Life in China". Illustrated.

Jan. 11, 1907. Mr. Warren S. Johnson, Milwaukee, Wis.,
"The Air We Breathe".

Jan. 18, 1907. Dr. Albert T. Clay, Univ. of Penn., Phila., Pa.,
"Babylonia In The Time of Abraham". Illustrated.

Jan. 23, 1907. Mr. George Wharton James,
"The Mysterious Salton Sea". Illustrated.

Jan. 25, 1907. Dr. E. P. Felt, Albany,
"Destructive Leaf-feeding Insects and Their Control".
Illustrated.

Feb. 2, 1907. Rev. Peter C. Goldsmith, Salem, Mass.
"A Visit to Some Mexican Aborigines". Illustrated.

Feb. 8, 1907. Dr. Carlos E. Cummings,
"Mexico". Illustrated.

March 8, 1907. Dr. Carlos E. Cummings,
"Old Mexico, To the South". Illustrated.

March 15, 1907. Mr. Frank A. Converse,
"City Milk Supply". Illustrated.

March 22, 1907. Mr. N. W. Shed,
"By-Product Coke and the Prevention of Smoke in Large Cities". Illustrated.

April 5, 1907. Hon. James S. Whipple,
"Protection for Forests, Fish & Game".

Mr. A. Knechtel,
"The Forests of New York State". Illustrated.

April 12, 1907. Dr. Carlos E. Cummings,
"North to El Paso. Old Mexico". Illustrated.

April 19, 1907. Special.
Prof. Herman C. De Groat,
"Around the Circle in Colorado, 1000 Miles Through The Rockies". Illustrated.

May 3, 1907. Rev. Charles Warren Currier,
"A Tour in Spain". Illustrated.

LIBRARIAN.

The Librarian, Mr. Philip S. Smith, reported that since his last report and since the date of the inventory the following accessions have been made to the Library.

Bound Volumes	37
Unbound "	200
Pamphlets	55
Publications received in exchange for our bulletins	1932
Donations from the President	89
" " Miss Letson	17

He called attention to the crowded condition of the library, compelling the storing of all foreign accessions and of early volumes of American journals in order to make room for more recent numbers. Of the 500 unbound volumes he recommended that the 350 American publications be bound and that for the present the foreign publications be stored.

A subject index is being made which when completed will greatly enhance the working value of the Library.

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