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PLATE I

MILTON S. BAXTER
1856–1938

THE BOTANICAL SECTION OF THE ACADEMY
CELEBRATED ITS SIXTIETH ANNIVERSARY ON

APRIL 13, 1941

THIS NUMBER OF THE PROCEEDINGS IS DEDICATED
TO THE BOTANICAL SECTION
AND
TO THE MEMORY OF

MILTON S. BAXTER

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE
VOL. 8, NO. 4, PP. 123-232 SEPTEMBER 10, 1942

EARLY BOTANISTS OF ROCHESTER AND VICINITY AND THE BOTANICAL SECTION, PART II [1,2]

ANNA B. SUYDAM [3]

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ILLUSTRATIONS

MILTON S. BAXTER
1856–1938

In the passing of Milton S. Baxter his family, his friends, and the community lost a unique and lovable character, and to the Rochester Academy of Science, particularly to the Botanical Section, the loss seems irreparable. He was for forty-five years a member of the Botanical Section of the Academy of Science, for thirty-two years its recorder, instructor and guide, and for ten years the curator of the Academy's

[1] Received for publication December 15, 1941.

[2] The article by Florence Beckwith, of the same title, Proc. Roch. Acad. Sci. 5: 39–58 (1912) is considered as Part I of this series.

[3] When the Botanical Section decided to prepare biographical memoirs of its most prominent deceased members and also a brief review of the Section to commemorate sixty years of its life, the author was asked to do the work. It would have been impossible except for the splendid assistance of the members of the Section. Special gratitude is due Dr. Grace A. B. Carter and Mrs. William L. G. Edson for their tireless and unfailing efforts. We are very happy that through the kindness of friends we have been able to secure pictures of the botanists of whom sketches are given.

Herbarium and of the Herbarium of the University of Rochester. He was a botanist unparalleled in knowledge of the flora of Rochester and adjacent areas.

Milton S. Baxter was of Scotch lineage. Two of his ancestors were signers of the Mayflower compact, and one, the Hon. John Carver, was the first governor of the Plymouth Colony, 1620–21. His paternal ancestor, Thomas Baxter, came from Scotland to Yarmouth, Massachusetts in 1679, and here he married Temperance Gorham. His great-grandfather John Baxter, of Sandisfield, Massachusetts, enlisted in the Revolutionary Army in November, 1775, and served until discharged in 1780. In 1813 the family was living in Westmoreland, Massachusetts, and from there his grandfather, Stephen Baxter, travelled to Western New York where he purchased a farm at Union (now Hamlin). He returned to bring his family and with them he brought two great iron cauldrons to use at a large deer lick he had found on the farm. By means of a caisson he deflected the water from a nearby stream and brought it down to his kettles. He heated the water with wood cut from his clearing and thus the Baxter Salt Works were formed. Men came on horseback from Monroe, Livingston and Orleans counties to carry home salt. This continued until the Erie Canal was completed, when the canal boats brought salt from Syracuse; the Baxter Salt Works then went out of business.

Milton S. Baxter was born in his grandfather's log cabin in Union on February 18, 1856. His father, James Harris Baxter, had married Esther Angelina Knowlton, who, with her father, emigrated from Rome, Massachusetts to Le Roy, New York, in an ox cart. James Baxter was a farmer and at twenty-one he took full charge of the farm from his father, who retired at forty-five. The farm was two miles north of Walker and two miles south of Lake Ontario. From here Milton Baxter and his brother Florus attended the North Star school which was only a quarter of a mile from their home. Years before, it had been known as the "Baxter School." One Joel Baxter, a cousin, would drive "to town" to get a newspaper and upon his return the neighbors would gather in this building to hear the paper read. Hence the name, Baxter School. In 1861 the family moved to Kane's Corners, now Walker, and James Baxter opened a grocery store. Here the boys attended the Rising Sun school. It was about three-quarters of a mile away and the road, following the vagaries of a brook, was as full of curves and twists, as the brook was full of good reasons to linger and loiter. One lovely spring morning their mother said: "Don't be late tonight. Come straight home." And they did, but in order to do so they had to ford the stream three or four times, and so arrived home more wet and bedraggled than ever. When their mother remonstrated with them Milton said: "But you told us to come right straight home and this was the only way we could do it." Thus he early showed his predisposition to have everything meticulously correct.

As soon as the boys were old enough, they helped in the store. At this time there were eight months in the school year, four in winter and four in summer. Milton went to school in winter and Florus in summer. The alternate months they "tended store." Very early they became interested in nature and all living things. Their parents were ever ready to encourage and assist them. Their father was a kindly, generous man with an experimental mind. He had played with magnets and electricity and had invented a machine for insulating wires. He fully understood the boys' desire to know the "whys and wherefores" of everything. He purchased Draper's *Insects Injurious to Agriculture* which became a storehouse of knowledge, not alone for them, but to the neighboring farmers as well. Patrons of the store brought in all sorts of insects and worms for identification. Their father bought a small printing press, intending to print small circulars advertising the goods in the store, but soon the brothers got out a little four by six inch pamphlet reporting news of the community and church and containing advertisements for local people. This became so popular, a larger press was purchased and the paper grew into a twelve by fifteen inch sheet called *Leisure Moments,* which was continued until both boys went away to school.

Another move of the family was to Garland (now Clarkson) in 1866, where they resided two years, moving to Adams Basin in 1868. Here was a good locality for more than one field of scientific observation. At the end of a half mile walk a stream flowed through limestone ledges exposed by the erosion of a sizeable creek. Trilobites and many other fossils were found here. In the same direction was what had been a woodland with the tree stumps still standing. Many ferns grew in the open spaces. About as far in the opposite direction was a cold bog, Jones Swamp (now Adams Basin Swamp) fed by seepage from the old Erie Canal. (The nearest similar swamps were Bergen and Mendon). This was a botanist's joy, so full of rare plants, among them Black spruce with its minute parasite Dwarf Mistletoe (*Arceuthobium pusillum*) sometimes called Witch's Broom. There were several orchids, including *Cypripedium hirsutum,* various pyrolas, with *Moneses uniflora,* and poison sumach (*Rhus Vernix*). Mr. Baxter often told of his introduction to poison sumach. Wanting fish poles, the boys went to the swamp to cut some. They selected two of soft, gray bark straight and limber. They used their father's saw to cut them and proudly carried them home. No ill effects resulted to either of them, but, after a day or two, their father used the saw and developed a good case of sumach poison. The spankings they received from an irate dad stamped poison sumach indelibly on their minds.

Milton Baxter entered Brockport Normal School from which he was graduated in 1878. It was here, working with Professor Lennon, that his love for botany was born. It was fostered by a visit to Dr. Samuel Beach

Bradley, one of the earliest botanists, if not the earliest, in this part of the country. Young Baxter, having heard Dr. Bradley was a great authority on botany, and that he possessed a fine herbarium, determined to make him a visit. He took what was then a long ride from Adams Basin to Rochester. He met with a most cordial reception, Dr. Bradley making particular inquiry as to what plants the young student was especially interested in, taking great pains to show him his herbarium, and treating him with the consideration he would have shown a grown-up. It was a memorable afternoon for the young visitor and he drove home a very proud and happy youth more than ever interested in botany. And not that alone, but the gratitude for Dr. Bradley's kindness stayed with him always, for so did he treat everyone, young or old, who came to him in the interest of botany, or any other natural science, for encouragement or assistance.

His first assignment for practical work was collecting, identifying, pressing and mounting twenty-five flowering plants. By the time that was completed his interest in botany was firmly fixed. His first mounted specimen was *Cypripedium acaule*. It is now the treasured possession of the Botanical Section. Even in those early days he discovered new plants, plants not to be found in Gray's *School and Field Botany* or any other book available to Prof. Lennon or himself. In a cleared woodland near his home grew two well-known ferns and midway between them was a third having the characteristics of the other two, but unlike either. The State Botanists to whom it was sent for identification pronounced it a hybrid. Here Mr. Baxter illustrated his habit of observing the most minute details and carefully weighing all points before deciding.

Mr. Baxter taught school in Adams Basin during the winter of 1878–79. After this he came to Rochester and began working with the Telephone Company shortly after the opening of the first office. Fifty-three subscribers were in the service and the operating force consisted of three, Baxter, another young man, and the chief operator. In 1880 he was transferred to the International Bell Telephone Company, and with three other American men was sent to Zurich, Switzerland, to build and put in operation a telephone system. He left Adams Basin on July 23, 1880, and Sandy Hook on July 28th. Arriving at Antwerp he signed the contract and then went on to Zurich, arriving there August 23, 1880. The work was completed in 1881, and turned over to a local Swiss Company. He then went to Amsterdam, Holland, where he had charge of the installation and drop gangs and later of all outside construction. In 1882 he laid out the work and began the construction of the Central Office at The Hague. He was transferred to Riga, Russia, in 1883, and put in charge of the plant work and traffic department of an exchange that had just been completed by the American construction gangs. He went to St. Petersburg in 1884 and after two years became Plant Superintendent.

In 1891 he returned to America and resumed his work with the Bell Telephone Company of Buffalo. In 1892 he went to Rochester as Chief Operator of the exchange that was then located in the Wilder Building.

While in Europe Mr. Baxter never lost sight of his vocation, nor did he lose interest in his many avocations. He collected hundreds of botanical speciments from the various countries, which have been of invaluable use for comparison and identification. They are now housed with the rest of his splendid herbarium as a part of the herbarium of the Academy at the River Campus of the University of Rochester. He brought back a rich mineral collection. He gained a speaking knowledge of the languages of the several countries, especially Germany and Russia, that he might converse more readily with charming Fraulein Julia Henko whom he met in Riga. Alike in their love of nature and of beauty, they so enjoyed their long walks that they decided from then to walk life's long path together. And so on January 12, 1884 they were married. She was the daughter of a prominent physician, an accomplished musician herself and the sister of a composer. Though quiet and retiring, Mrs. Baxter was gentle and lovely with a beauty of mind and spirit that fascinated one. She was keenly in sympathy with all of her husband's many interests and shared them whenever she could. She never became quite used to American ways and sometimes longed for the old home life in Russia. After a trying illness of eleven years, during which she was a most patient sufferer, she died September 23, 1929.

Their only child, Tamara Pauline, was born in St. Petersburg, April 16, 1885. She is now Mrs. Kendrick P. Shedd and resides at Kenmar, Naples, New York.

On coming to Rochester after one year in Buffalo the family went to 46 Bly Street, where Mr. Baxter, his daughter and her husband were still living when Mr. Baxter died. They sent their household goods from Buffalo to Rochester on the Erie Canal. On one side of the boat was their property and on the other side a load of lead. In the midst of a gale the poorly balanced boat was overturned and their goods were two nights and two days in the bottom of the canal. Among their possessions was Mr. Baxter's herbarium. The effects of the two-day soaking can still be seen on some of the specimens.

After the completion of the first Fitzhugh Street office in 1900, the first common battery office in Western New York, the Telephone Company transferred Mr. Baxter and he became trouble foreman and later installation supervisor. He was made chief clerk to the plant supervisor in 1908, continuing in that position for twenty years. At the completion of his fiftieth year in the service, a dinner was given in his honor. He was presented with a diamond service emblem, the first of its kind in New York State and perhaps in the country. He also received a purse of gold contained in a miniature apartment telephone. From then until the termination of his service with the company he held an advisory position at the plant. His retirement permitted him to devote all his time to his beloved botany.

Milton S. Baxter seems to have joined the Botanical Section in 1893, the year after his return to Rochester. At least at the regular meeting July 17th the minutes read: "Mr. Baxter exhibited *Calopogon pulchellus, Pogonia ophioglossoides, Nymphaea odorata* and *Rosa caroliniana* from Mendon," and from then until his last meeting with us, in September 1938, very rare were the minutes that he did not read "Baxter exhibited—." He made field trips to the then new and unworked stations with Prof. Lennon, receiving acknowledgment of rare plants from Adams Basin and Holley. And then came Bergen, Mendon, and Busnells Basin, all yielding new and unknown specimens to be studied and identified at the Section meeting. We have heard of his tales of botanizing on a bicycle; his driving over country roads with his pal, Mr. V. Dewing with horse and buggy, bringing back treasures from the Gulf, from Penfield Dugway, and from Sullivans; searching out unusual swamps and promising hillsides, fairly scouring the ground until he knew every grass and sedge and blossom as it appeared; and then farther afield, at Junius Ponds in Seneca County, Mud Pond in Wayne, Oneida Lake and the surrounding country, the Adirondacks, New England, Canada, Washington and its environs, and the hot sand plains of New Jersey. In the field he was always cheerful and happy, always oblivious of weather or untoward circumstances, always devising a way out of difficulties. We remember an early summer trip to the swamp at Coldwater when it rained all day. We had planned to cook a lunch and everything was soaking wet. Nothing daunted, Mr. Baxter tore down a rotting stump, lighted the dry punk within, raised an umbrella over it, and we cooked our meal. Some friends who went with him on a botanizing trip to the Sand Plains of New Jersey said that the mercury stood at 110° F., and although the others sought the shade, Mr. Baxter worked on unconscious of the heat which did not seem to affect him. No swamp was too deep for him to wade, no mountain too high to climb. Everywhere people meeting him realized his wealth of knowledge and the greatness of the man. Vacationing in Algonquin Park one summer we were talking with the Park Superintendent in his office and chanced to mention Rochester. A man asked "Rochester, New York?" "Yes." "Do you know M. S. Baxter?" Did we! Said he: "He is a wonderful botanist and a splendid man. A great treat to botanize with him." The man was Dr. Frank Morris.

Mr. Baxter frequently made special studies of a single species, carrying it through season after season, and from one to many locations. Soon after joining the Section he found that while Gray's *Field and School Botany* described only twelve species of *Crataegus,* there were endless variations among the hawthorns in the Genesee Valley. Specimens of flowers and fruit were discussed with Mr. C. C. Laney and Mr. John Dunbar and the results were reported to Dr. C. S. Sargent of the Arnold Arboretum of Jamaica Plains, Massachusetts. The following quotation from an article in these Proceedings[4] attests Dr. Sargent's appreciation of the work of the Section and its dependability: "During a visit which I made in Rochester in the autumn of 1899, Mr. C. C. Laney, the Superintendent of Parks of that city, called my attention to a number of forms of *Crataegus* which seemed unlike any of the described species and this hurried examination led Mr. Laney, his assistant Mr. John Dunbar and Mr. M. S. Baxter to make a careful and systematic study of the groups in the neighborhood of Rochester and in parts of the adjacent country. . . . Thanks to the industry of Mr. Laney and his assistants, *Crataegus* has now been systematically and carefully studied in Rochester for three years." All the members of the Botanical Section, who were working in it at that time, would recall those three years when a diligent study of *Crataegus* was a part of every meeting, with Mr. Baxter, the interesting instructor. It seemed as if we had gone on a mental diet of thornapples.

Mr. Baxter shared Bergen Swamp and other homes of orchids and other rare plants with Dr. Frank Morris and Dr. Edward A. Eames, authors of *Our Wild Orchids;* Dr. Homer D. House, State Botanist at Albany; Dr. Karl Wiegand of Cornell University, and a host of other delighted botanists. He visted Bergen Swamp regularly, season after season, year after year, until its richest treasures became his. He was leader of field trips to Bergen for countless numbers of people, carefully directing, patiently listening to their often stupid questions, generously sharing his knowledge and willingly giving his time. So well did he know Bergen Swamp that even the rattlesnakes were his friends, and though he would not fondle them as we would any other of our native snakes, he objected to having them killed.

Recognizing the inevitable extermination of many of our rare plants if the wholesale picking of the flowers or digging of the plants was not stopped, Mr. Baxter was an ardent conservationist. He was a charter member and trustee of the Bergen Swamp Preservation Society, whose purpose is to make Bergen Swamp a Sanctuary for Wild Life. He worked for the protection of the Northern Lotus (*Nelumbo lutea*) at Sodus Bay and he was one of the founders and most diligent workers of the Burroughs-Audubon Nature Club, and instrumental in establishing and maintaining the Club Conservation Station at Railroad Mills.

Milton S. Baxter was elected to membership in the Rochester Academy of Science in November, 1897, and was made a *fellow* in March 1898, and a councilor from 1911 to 1919. He was Secretary, pro-tem, of the

[4] Proc. Rochester Acad. Sci. 4:93–136 (1903).

Botanical Section from 1906 to 1909 and recorder from 1909 until his death in 1938. He was the Curator of the Academy herbarium and of the herbarium of the University of Rochester; and was a member of the summer school faculty of the University of Rochester from 1928–1938.

Although he spoke fluently in five languages, Mr. Baxter shunned the platform; the reading of the Annual Report of the Botany Section before the Academy was a real ordeal for him, but in a small group or with familiar friends he was an interesting and delightful speaker. His versatile mind had always a wealth of knowledge to impart and his keen understanding and ready wit were eagerly sought after. His interests were widespead, not alone for his special hobby of botany, but for geology, entomology, ornithology, archeology and numismatics, as well as history and literature. His home was a veritable museum: his herbarium with its thousands of sheets, self-collected or secured by exchange from many parts of the world; a fine coin collection; mineralogical and geological collections; a notable collection of Indian artifacts; Russian curios and a fine library.

Several plants were named for Mr. Baxter. We recall *Viola Baxteri* and *Crataegus Baxteri*. In the *Annotated List of the Ferns and Flowering Plants of New York State* (House). *The Flora of the Cayuga Lake Basin, New York* (Wiegand and Eames), and *Flora of the Niagara Frontier Region* (Zenkert), M. S. Baxter is frequently mentioned as finder of some new plant for Monroe County and adjacent territory.

He was the very heart of the Botanical Section giving to it his constant interest and untiring efforts. He was recorder, instructor, guide and to each member a familiar friend, generously sharing his knowledge, patiently bearing with inevitable errors. One of the greatest field botanists in this part of the country, he knew the remote spots where such vanishing Americans as wild orchids, the gentians, the arbutus and rare ferns may still be found. He was animated by an unquenchable enthusiasm for growing things which he shared liberally and infectiously. He was also truly one of the great men, gentle and lovable, with a happy spirit that saw always the good in people and the sunshine behind all clouds. Milton Baxter enjoyed excellent health until a short illness which resulted in his death on October 15, 1938.

PAPERS OF MILTON S. BAXTER

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Beckwith, F., M. E. Macauley, and M. S. Baxter. 1917. Plants of Monroe County, New York and Adjacent territory. Second Supplementary list. Proc. Rochester Acad. Sci. 5:59–121.

Baxter, M. S. and H. D. House. 1925. Rare plants of Bergen Swamp. Report State Botanist for 1924, N. Y. State Bull. 266:103–106.

Baxter, M. S. and T. P. Maloy. 1932. Arboriculture at Rochester, N. Y. Proc. Rochester Acad. Sci. 7:39–58.

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APPRECIATIONS OF MILTON S. BAXTER

In any appraisal of the botanical work of Milton S. Baxter the first thought is of his remarkable knowledge of the local flora of the Genesee country. If we examine the source of this knowledge we find, as in the case of many other students of local floras, such as Sartwell, Bradley, Kneiskern, Day, to mention but a few, that this knowledge comes from extensive field work and the collection, preservation and study of herbarium material. There is sometimes an inclination to belittle the importance of an herbarium. I have only to point out in this connection that with the passing of time and the revaluation of diagnostic characters in regard to certain or many species of plants which show throughout their range a definite response to varying climatic or geologic factors, the collected and preserved herbarium speciments are invaluable in the redeliniation and varietal makeup of the species. For the student of special groups, such as sedges, grasses, ferns or any one of several large and complex genera of flowering plants, again the local herbarium affords valuable data for the region covered. Again I might mention the fact that someone is certain to undertake a restudy of the local flora of the Genesee country. Such a study must also revaluate all former reports of species for the area, and unless the specimens upon which the reports were based are available many such records may prove to be almost worthless. The point of all this is that Mr. Baxter's plant collection should be most carefully preserved.

I would like to approach this appraisal of Mr. Baxter in a more personal way. I have had, however, only a few but delightful trips afield with him. These few are sufficient to designate them as milestones along life's journey. Humor, goodwill, appreciation, and above all the glad willingness to share all he saw with his companions,—these were his characteristics. A keen discrimination of the rare and unusual in plant life was always uppermost. Hence his herbarium came ultimately to contain an almost complete representation of the Genesee flora.

Few of us knew much of his occupation. To most of us he was known as a botanist. That was his avocation, his recreation, and, almost I might add, his reason for living. It was almost by accident, while he once recounted to me some of his collecting experience in Russia, that I learned that he was in some way connected with the telephone industry. As an instance of his discerning sight, he collected in Russia some specimens of moonwort which are exact matches for the local plant known as the Onondaga moonwort (*Botrychium Lunaria* var. *onondagaense*), known to us only from Onondaga and Genesee counties. The incident is worth mentioning here as it indicated his ability to detect the unusual when afield.

Against all this the more practical minded may place the fact that he spent many, many hours and days in botanical work, using considerable of his private funds to promote it, and maintained at no inconsiderable inconvenience to himself and family a large and growing herbarium. Such is the usual experience of the scientist devoted to his subject, who is not professionally engaged in some more or less remunerative work along his chosen line.

Mr. Baxter reaped his own reward in doing what he liked best to do, perhaps sometimes under difficult handicaps. He made contacts and lifelong friendships and professional acquaintances which otherwise would not have come his way. He took a humble pride in placing some of his knowledge into printed and permanent record. Such was his reward and we honor him for his services to our local botanical work and regret that he did not leave to us in printed form a larger portion of that knowledge of the Genesee flora which he possessed.

H. D. House
State Botanist

* * *

There is no need for me to tell of Milton S. Baxter's reputation as a botanist,—he was altogether too well known. I shall try, rather, to tell some of the vivid impressions he made on me as a man and a scholar, as a companion on many a field jaunt, and as a teacher.

Mr. Baxter was so unassuming that it took some time for anyone to appreciate the broad scope of his interests. He was a specialist in but one phase of botany,—taxonomy—yet he knew what was being done in all phases of the subject. And botany was his "hobby," studied on holidays and late of nights; for his life occupation was with the Telephone Service. During the earlier years, driving, he came to know all the roads in the area centered around Rochester, and at the same time to know where the choicest collecting grounds for plants were to be found. Thus his two-way mind was alert to both his job and his hobby.

Of all the many trips we made together, I shall mention just two,—one by ourselves, the other in company with a large group of professional botanists,—as showing two different facets of his character.

One day Mr. Baxter and I went to Bergen Swamp for general exploration and also to get good specimens of a particular sedge, so small as to be hidden by its taller neighbors. You must picture two rather oldish men crawling on all fours, with the rain pelting on their backs. We got what we went for; our wet feet and backs were incidental spicing of the trip. Botanists never catch cold on a field trip. One year the Botanical Society of America met at Toronto; and the big excursion was to Owen Sound, where we spent a full day in the swamps. The car in which Mr.

Baxter rode got in ahead of me. My first sight of him was as he waded toward me through the water way over his shoes (of course it was raining), holding up a fine bouquet of his pet orchids, and saying *"Isn't this grand."* Perfectly typical of the man. As on all such trips, introductions were very informal. He soon knew who other men were, and they knew him at once when his name was mentioned.

In 1929, when I was absent on leave, I had arranged for Mr. Baxter to take the class in Field Botany, in the Summer School. From then on, till the end came, the course was his course. I easily persuaded my advanced students in the Arts Department to stay over for this summer course—and I went along mainly as a passenger. The students all liked him at once. He was young as the youngest, and incidentally could outwalk them.

Mr. Baxter was also Curator of the University Herbarium, and was a great help to everybody in the department. He declined a salary, preferring to be paid by the hour. This left him free to go out to the fields whenever the weather permitted. Except in the dead of winter, we never expected to see him on a "nice day."

This rambling account is perhaps the best way for one field botanist to describe another. After so many years of close association I could not be formal. Nor could I hope to tell the complete story. I have tried to illustrate some of the fine traits of Milton Baxter's character. Around these mere glimpses everyone who knew him can fill in from his own treasured wealth of memories.

WILLIAM DAYTON MERRELL,
Prof. of Botany, Emeritus
University of Rochester

* * *

I would rate Mr. Baxter as one of the most important botanists of New York State during the last generation. He was not only keenly interested in the wild flora of his own region, Monroe County and adjacent portions of New York State, but he was a keen student as well as having a careful analytical knowledge of the plants growing in this region. He was always a fine addition to field trips, his enthusiasm being contagious. No field trip was quite complete without him as a leader. Personally, I have enjoyed my acquaintance with him and have only regretted that distance has made personal contacts so infrequent.

K. M. WIEGAND,
Prof. of Botany
Cornell University

* * *

I am very happy to be given the opportunity of expressing my appreciation of having had the privilege of the friendship of our dear Mr. Milton Baxter. It will probably be only those who knew him who will guess what I mean when I say "dear" Mr. Baxter. One could not help but love him and one could not spend an outing with him but be influenced for a better life. Surely if it is possible for men or women to leave something behind them that endures, he is among those who have left something for those following to emulate and copy.

It was indeed a great thing for me to have had his friendship.

George Wendt
Rochester, New York

* * *

My first acquaintance with Mr. Milton S. Baxter dates back to about the year 1916 when I met him in the home of Alvin H. Dewey, one of the leading promoters of the archeological society then being formed. Before that time, however, I had had some correspondence with him in relation to the location of aboriginal sites in the Genesee Valley. It was always a pleasure to get his reports because they were not only thoroughly planned but generally accompanied by full quadrangles or sections cut from quadrangles of United States topographic maps.

Coming to Rochester in 1924, I found Mr. Baxter a good backer and sincere friend; in fact he was one of the three signers of my application to the Civil Service Commission. Mr. Baxter was frequently in the museum and was a great favorite with the young people upon hikes of which he was very fond. I well recall a spring hike with him through the swampy waters of Powder Mills Park where, spying an orchid, he waded in with his umbrella under his arm and several of us followed unaware that we were wading in the mire up to our knees. We looked at the flower and left it and he felt quite satisfied that it would remain there unmolested to spread its seeds and so multiply.

At another time we saw a great field of pink lady slippers on the hillside of Honeoye Lake, but oddly enough they appeared to have been affected by the frost for there had been a heavy snow about the 18th or 20th of May that year.

Mr. Baxter was always interested in the museum and in any subject which might advance its welfare. He sent a considerable number of pamphlets, books and frequently specimens to us as gifts. It was an occasion of frequent remark by those who were thrown with him that he was one of the most sincere characters that they had ever known. His graciousness and urbanity were truly winning and it was this quality of sincerity that permeated his entire life and affected his scientific studies as well as his relations with others.

Arthur C. Parker, *Director,*
Rochester Museum of Arts and Sciences

FLORENCE E. BECKWITH

1843–1929

The Rochester Academy of Science and especially the Botanical Section owes a debt of gratitude to Florence Beckwith for the devotion of her high abilities and unfailing purpose to the work of the Section. Her sterling character and rugged worth came to her through a long line of noble ancestors. The family emigrated to New England in 1635 and later one branch moved to Cornwell, Nova Scotia. Here Florence Beckwith's grandfather, Samuel Beckwith, was born in 1773. He married Adelaide Le Brun, daugther of Jean Baptise and Mdme. Le Brun. They removed to Sugar Island, Maine, in the upper St. John's river, later tarried for a short time at Montreal, and went thence in 1809 to Fairfax, Vt. From there in 1813 he set out with his family for Ohio but sickened on the way and died in Buffalo, New York where he had intended to wait for spring. The family turned back to the Genesee Valley and in about 1813 settled at West Henrietta, Monroe County, New York. Francis Xavier Beckwith, son of Samuel and Adelaide Beckwith, was born on Sugar Island, Maine, May 29, 1808. There Francis Beckwith received his education finishing at Monroe Academy in East Henrietta. Between 1821 and 1828 he lived in Canada. Returning to Henrietta for two years he taught school. In 1830 he began the manufacture of furniture in Scottsville and was in that business more than thirty years. In 1876 he removed two miles westward to the town of Gates.

Florence E. Beckwith, daughter of Francis and Hannah Goodhue Beckwith, was born in Scottsville, New York, December 7, 1843. She was associated for many years with the firm of James Vick, Seedsman, as editor of *Vick's Magazine*.

She was one of the eleven charter members of the Botanical Section and from the first one of its most ardent and indefatigable workers. She was vice-president from 1886 to 1897 when upon the resignation of Miss Macauley she was elected chairman which office she held until her death in 1929. From the first Miss Beckwith took her membership as a serious duty and a pleasurable privilege. She was most punctilious in her attendance at the meetings. Neither heat nor cold, wind nor storm could deter her coming. From the minutes of the Section of Jan. 28, 1888 we quote: "No meeting was held on this date owing to the severe storm and intense cold. To Miss Florence Beckwith belongs the honor of braving the elements and constituting the Botanical Section." Not only was she concerned for herself, but she was quick to remind any member who seemed to her to be remiss in duty or neglecting his privileges by his absence. She would say "You should remember Monday night is Botany night. You should plan for it." Always before her was the same goal as an objective since the organization of the Section: "No tree or shrub or herb in Rochester or vicinity that has not yielded up one of its secrets" and happily she lived to see her aspiration practically attained.

She presided at the meetings with a serious dignity, frowning on all frivolity; to her it was business and any infringement was rebuked by her gavel. That she had always felt the usefulness of the gavel as a check to human frailty was evinced by a note in the minutes of Dec. 30, 1892: "Miss Beckwith made a few humorous remarks stating that she had noticed the difficulty the President experienced in preserving order in the meetings, therefore she would present her with a gavel in order that she should use the same to enforce her authority. The President responded in like manner, thanking her for the gift and assuring her that with its assistance 'order must and shall be preserved.'" She was most conscientious and meticulous in her work and a keen observer and careful collector in the field. She worked quite independently and would sometimes wander off and get separated from the group. On several occasions this happened in Bergen Swamp, much to the consternation of the others, but when discovered she would be quietly working, unconscious of having lost the way or caused any anxiety. Indeed she would have been affronted if she knew anyone was worrying about her.

No words can express what she accomplished for the Section. She was ever on the alert to further the interest or to add to the herbarium. Through her instrumentality several valuable collections were added to it.

She traveled to California, twice to Colorado, to Lakewood, N. J., and other interesting points sending home hundreds of pressed specimens, which upon her return, were identified, mounted and placed in the herbarium of the Academy. Very much of the spendid western portion of the herbarium is due to her. Untiringly she would climb mountains or ford rivers for a coveted flower, would labor patiently to press and repress it, carefully placing the plant to best preserve each least detail of form or color. She would change the driers again and again to make the perfect specimen.

After retiring from the firm of James Vick, Seedsman, she devoted all her time to the Botanical Section, spending long hours mounting and labelling, arranging and rearranging. Deep, indeed, is the debt of gratitude the Academy owes to her tireless devotion.

Miss Beckwith read several papers before the Academy, and her publications are listed below. Her name appears frequently in the State Report by Homer D. House. Dr. C. S. Sargent named one of the Genesee Valley species of Crataegus for her. For years she was a councilor of the Academy of Science by whom she was made a Fellow. She was deeply interested in the plan to make Bergen Swamp a Wild Life Sanctuary. As early as 1913 the records recount a correspondence with A. J. Squires of Genesee County, relative to the establishment of a Bird Sanctuary in Bergen Swamp. She was jealous for the preservation of all wild flowers and always had a ready rebuke for intemperate picking of them. She would say "Flowers have nerves, I have seen them tremble when you picked them." She was conservative in her friendships, living much to herself, but there was a sweet, gentle side to one who sought for it. A beautiful story is told of her fidelity. Her lover fell in battle in the Civil War and was buried in Riga. Each year as long as she was physically able Miss Beckwith made a pilgrimage on Memorial Day to place flowers on his grave. A mute tribute to a love that never failed. Her death was caused by an accident, and she died on August 9, 1929 at the home of her niece, Mrs. William J. Howe of Scottsville.

PAPERS OF FLORENCE E. BECKWITH

Beckwith, Florence. 1893. Variation of ray-flowers of Rudbeckia hirta. Proc. Rochester Acad. Sci. 2:170–171.

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Beckwith, Florence and Mary E. Macauley. 1896. Plants of Monroe County, New York and adjacent territory. Proc. Rochester Acad. Sci. 3:1–150.

Beckwith, Florence, Mary E. Macauley, and Milton S. Baxter. Plants of Monroe County, New York and adjacent territory. Supplementary list 1910. Proc. Rochester Acad. Sci. 5:1–38.

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GEORGE T. FISH
1838–1926

George T. Fish, the son of Benjamin and Sarah (Bills) Fish, was born on August 2, 1838 in that part of Rochester which, in the early days was known as the "Ruffled Shirt Ward." Mr. Fish was ever very emphatic in declaring that his parents had no part whatever in bestowing the title, for they and their ancestors before them were members of the Society of Friends and hence wore the plain garb which, at that time, characterized that denomination.

Between the ages of seven and eighteen Mr. Fish attended common school from time to time during five or six months each year—equal in all to about five years. He worked in his father's nursery from spring to fall. At sixteen he superintended the planting of nursery stock consisting of between fifty and one hundred thousand grafts and stocks for budding. At twenty he was able to walk across the rows of pear trees, even when there were no leaves on them, and readily recognize every variety by its appearance.

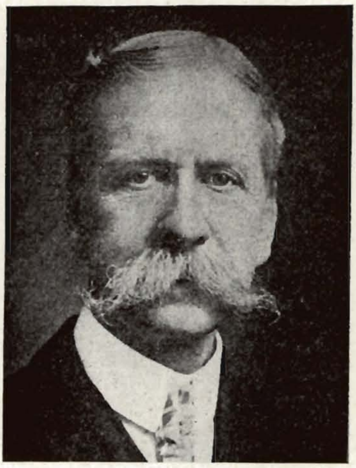
Mr. Fish attended Rochester High School for a short time when he was nineteen years of age. He taught school in the country one winter when

Plate II

Florence E. Beckwith
1843–1929

Jennie M. Dennis
1852–1937

Mary E. Macauley
1851–1932



George T. Fish
1838–1926

he was twenty-three. He used to say that partly to make up for the short time spent in school he had been trying to learn something ever since school days. He was interested in the study of chemistry, geology, ornithology and entomology. His vocations were nurseryman and horticulturist. His spare moments were devoted to teaching parliamentary law and botany and making genealogical investigations. His hobbies were botany and genealogy.

Mr. Fish was a member of the Western New York Horticultural Society and the National Nurseryman's Association; also of the American Association for the Advancement of Science. He was a Life Member of the Rochester Academy of Science. On the organization of the Botanical Section in 1881, he became its first president, which position he held for a year. Before this he was actively interested in botany as his name, along with that of Mr. J. B. Fuller and Mr. E. L. Hankenson, appears in the *Botanical Directory of America*—1878.

It was Mr. Fish who discovered that a swamp in West Bergen contained many rare plants—Bergen Swamp which has become a Mecca for so many botanists. Here he also found the little white lady's slipper, *Cypripedium candidum,* the first time it was reported for New York State. He made botanizing trips with many prominent scientists including Asa Gray. He was an indefatigable worker, covering our own and the adjacent territories and bringing in many rare and beautiful specimens.

His large and varied herbarium containing many remarkably well preserved specimens was given to the Academy and is one of the most highly valued contributions to our collection of local plants. Mr. Fish's botanical work extended over many years and his keen interest never lessened. His memory was good and his presence at the meetings of the Section was greatly enjoyed by all.

He was most unassuming, gentle, quiet and retiring—enjoying to the utmost his love of nature and the beauty he found in the flowers. Very characteristic was a note written to the Section shortly before his death, in reply to a request to name the three most popular flowers:

"1. *Nymphea odorata.*

"2. *Cypripedium acaule* var. Rose Pink.

"3. Gentiana crinita.

"As No. 1 possesses such charm, grace, purity as well as fragrance, but also stands nearly at the head of the list of flowers in botanical construction, I fancy a number of others will also place this plant at the head of the list. As I was the first to find that *Cypripedium candidum* grew in this state, I might have placed the white lady's slipper as second on the list, but in the summer when I could not have been more than ten years of age, I found in bloom two species, one yellow and the other rose pink.

The latter won my heart and has retained my affections ever since. I lived at Sodus Bay the summers of 1844, '45 and '46. I did not have the privilege of seeing this species again until 1893. After I had seen all the species named in the botany save *C. arietinum,* I wondered why I had not seen my pretty rose pink beauty. I had carried the general shape and distinct beauty of color in my mind for forty-seven years; but did not have the privilege of seeing it again until the summer of 1893. It was a wonder to me that anything so distinctly beautiful was not described in the books.

"At last I found by the side of a large tree in Bartholf's woods, Greece, Monroe County, a clump of thirteen beautiful blooms and at once realized that the lost had been found. When I had examined both of my editions of Gray I saw that it gave in small type a variety of *C. acaule* as rose pink. We took it home in a bushel basket and planted it in our wild garden."

MARY E. MACAULEY
1851–1932

Miss Macauley was born in Rochester, New York, of Protestant Irish ancestry. Her parents, Robert and Jane Macauley, emigrated to America from North Ireland, and upon reaching New York came up the Erie canal to Rochester.

An apt, enthusiastic scholar, of keen perceptions, Miss Macauley succeeded in whatever she undertook. She attended the public school and was graduated from the Free Academy in 1872. She taught several years in Public School No. 14, resigning in 1882 to take a position in Miss Lewis' Private School, remaining until Miss Lewis married and the school was closed. From 1886 to 1890 she was Preceptress in Fairport Classical Union School. She taught English, physical geography, and the sciences. She was so fascinating and presented her work in such an attractive manner, she won the regard of all her pupils who were glad to co-operate with her in classroom or study hall. Botany was her favorite subject. She delighted in taking her class on long hikes. One of the favorites was the Genesee River Gorge. She would explain the geological features (the outcroppings along the gorge) and at the same time collect botanical specimens from the long familiar Maplewood trail for class study. She had a keen mind and a delightful sense of humor as well as a good bit of real "Irish wit." She knew her subjects and was interested in her pupils, helping them to look forward and to do their best. She taught school in Auburn for a short time, and then in 1893, more than twenty years after her graduation from High School, she matriculated at Cornell University from which she was graduated with high honors in 1898.

Mary E. Macauley was one of the eleven charter members of the Botanical Section, was secretary for two years and president for eleven years, from 1886–1897. She was a most tireless worker both in the meetings and in the field. Except for absences from the city she was a regular attendant at the meetings. For fifty-one years she watched the growth in interest for the Section, saw the limits of the field for collecting pushed farther and farther, saw many new and rare specimens from new and old stations, shared the enthusiasm and satisfaction of a greater and greater herbarium and exulted as the goal she had helped to fix grew nearer and nearer its fulfillment, rejoiced perhaps the most that it never could be reached. There will always be "new or rare specimens in new or old localities."

Miss Macauley made frequent trips into other states to study the flora. She spent weeks botanizing in Manitoba, California, Colorado, Tennessee and for the later years, as long as she was physically able, she spent the winters in Florida. From every place she brought large collections of unusual plants which she pressed, mounted, and identified and they are now a part of the herbarium of the Academy of Science.

Mary E. Macauley was a co-author of the three *Lists of Plants of Monroe County and Adjacent Territory,* published in these Proceedings (see page 138). She was a Life Member and a Fellow of the Academy. In later years because of serious eye trouble, she was prohibited from enjoying her much loved reading and study, nor could she analyze flowers, though she could usually recognize familiar ones. An operation was ineffective in restoring her sight sufficiently for reading or any detailed work, which was a grievous cross to one who had given so much of her life and always her love to it. She bore it patiently and uncomplainingly, keeping her interest alive and her mind alert and cheerful. She lived with a niece, Miss Jennie Adams, then of Pinnacle Road, at whose home she died in 1932, being the last of the Charter Members of the Botanical Section.

The following tribute comes from one who was her student in the Fairport Classical Union School:

AN APPRECIATION

The four years that I was in the academic department of Fairport Classical Union School, from 1886 to 1890, Miss Macauley served as Preceptress, teaching the Sciences and English; she had a brilliant mind and a choice spirit, was vivacious, enthusiastic, taking a personal interest in the individual pupil. Botany was her best-beloved subject and it was a joy to go with her classes when she took them on nature hikes; the Genesee Gorge was a favorite trail with her, and under her instruction geology and botany became living subjects. She was a wonderful teacher, yet it was not so much what she taught that stayed with her pupils, and became a part of their lives, as it was the influence that came from her high type of womanhood, for this could not fail to make a lasting impression. In the early days of the Botanical Section of the Rochester Academy of Science she was one of the enthusiastic supporters, an associate of Miss Florence Beckwith and Milton S. Baxter, giving freely of her strength and talents until failing health and impaired eyesight forced her to relinquish the work which she so dearly loved. In 1930 and 1931 she came frequently to our wild garden which she greatly enjoyed, and it was a delight to talk over old times in Fairport High School. Although frail in body, she never lost the sparkle and charm of personality that characterized her youth. It was a great privilege to have known her and it is a satisfaction to offer this as a tribute to her memory.

MRS. FRANK W. PUGSLEY,
Pittsford, New York.

JENNIE M. DENNIS
1852–1937

Mrs. Jennie Markham Dennis, the daughter of the pioneers Augustus and Olive Louise Parmalee Markham, was born in Bloomfield, New York, August 21, 1852. She attended the Lima Seminary and was later graduated in the art course from the famous Ingham Institute in LeRoy. She taught for some time in the home district school, Lime Kiln No. 8. At twenty-one she married John Dennis, at one time publisher of the Lima Recorder and for forty years on the editorial staff of the Rochester *Democrat and Chronicle*. They were married in the historic Markham stone house on the Markham Road, Lima. The officiating clergyman was the groom's father, Rev. John Dennis, a veteran Methodist minister.

From that time Mrs. Dennis' love for the artistic and beautiful was transferred to her home to which alone she ministered until her family was nearly grown. Always she had an interest and delight in flowers. In 1910 she joined the Botanical Section and immediately became one of its most interested and tireless workers both in the field and at the meetings. She loved all things in nature, but her keenest delight was in her garden which she truly created.

In 1912 the Dennises built a new home at 75 Bellevue Drive. The house was surrounded by sand which covered the entire lot. Mrs. Dennis had visioned a garden and immediately began working for it. Inch by inch and foot by foot she enriched and cultivated and then set out plants and scattered seeds. Many old garden favorites and hosts of wild flowers found a home there. On the field trips of the Section, instead of a press or portfolio, she carried a basket and trowel and brought in growing plants to transplant to her garden. As the space filled, she added more and more ground, until hers became one of the most interesting and loveliest gardens in this vicinity. Roses and daffodils, forget-me-nots and pinks hobnobbing with beds of native ferns and wild flowers; trees and shrubs not only from our area but from the Adirondacks, Yonkers, and Long Island. Everywhere Mrs. Dennis went she brought back some plant to add to her treasures until the one-time sand lot was made to "blossom like a rose." A small greenhouse made it possible to cultivate the more tender and exotic plants as well as to test seeds and try out new varieties. Mrs. Dennis' special pride was her very wonderful collection of Solidago and wild asters. Practically all known varieties and, by hybridization, many new ones, were included. When in bloom that was a beautiful corner of a beautiful garden. Mrs. Dennis spent many hours in her garden—cultivating, transplanting, or visiting—for to her flowers were her friends. To meet her there and share with her the joy of the "green things growing" was a coveted privilege.

While still active and interested in the Botanical Section and her garden she was stricken with a paralysis that, for four years, kept her a captive. Throughout it all the garden she could see from her window was still a comfort and joy to her. She loved every flower brought to her bedside. She died July 21, 1937. Mrs. Dennis was gentle, winsome and kindly—eager to show kindness, to praise, and not to censure. She looked for good in everything and in everybody. She was a devoted mother and a loyal friend.

WORK OF THE BOTANICAL SECTION

On the evening of April 13, 1881, a group of interested people accepted the invitation of their hostess and met at the home of Major and Mrs. William Streeter, 11 Scio Street, and organized the Botanical Section of the Rochester Academy of Science which has now attained its sixtieth year. Its first president was Mr. George T. Fish, and its secretary was Mrs. Mary E. Streeter. The other charter members were Mrs. Thomas Spencer, Mr. and Mrs. A. B. Leckenby, C. W. Seeley, C. M. Booth, J. B. Fuller, H. C. Maine, Miss Florence Beckwith and Miss Mary E. Macauley.

The avowed object of the society's existence was the work of making a collection of the flora of Rochester and vicinity. "We believe," wrote the secretary, "the work is in the hands of those who will not rest from their labors as long as there is an herb, shrub or tree that has not yielded up at least one of its secrets."

The young society was most interested and alert. Quoting the records of June 13, 1881: "About 130 specimens have been collected and named.

Thanks to the energy of a few members a large portion of the flowers collected will be in readiness to exhibit at the coming Annual Reception of the Academy as herbarium specimens. This will be the nucleus around which will gather our constantly increasing collection." Thus was laid the foundations of our still mounting herbarium.

That the work of the Section was arousing a widespread interest in people of other localities is evident by the following from the record of June 20: "The secretary has received letters from a number of persons in adjoining counties, making inquiries concerning our work, offering specimens and altogether exhibiting such a gratifying interest in our work and the affairs of the Academy as to call to mind the couplet 'See how far the little candle throws its beams.'

"So shines a good deed in this naughty world."

In September 1881 it was voted to adopt Gray's Botany for study in the Section.

Mr. George T. Fish was president for one year and was followed by Mrs. Mary Streeter who remained in that office until her death, June 1885. Very early in her first year the following program, to be used in each meeting, was adopted: first, reading the minutes; second, stated paper; third, discussion; fourth, report on periodicals; fifth, discussion; sixth, exhibits by members as called upon. For the most part the meetings have been held the first and third Monday of each month, for the entire year. For a time the Section met in the rooms of the Academy in Reynold's Arcade. In 1889 Mr. Streeter invited the Section to meet at his house which plan continued for twenty-six years, when it moved to the Eastman Building on the Prince Street Campus of the University of Rochester, its present place of meeting.

During the years at Mr. Streeter's, because of his splendid equipment and facilities, much microscopic work with algae, mosses and lichens was done; but always the primary objective has been collecting, identifying and preserving the native flowers. Through the years the specimens have come from near and far; members of the Academy have collected in southern states, western states, northern states and in Canada. By personal collections or exchange, we have contributions from many foreign lands. The first donation to the herbarium was in 1885, a collection of Arctic plants gathered by Lieut. Kislingbury and presented to the section by his brother. It is interesting to note some of the other collections now a part of the herbarium: The Charles W. Seeley collection of 1500 ferns; the Samuel Beach Hastings collection; the J. B. Fuller collection of 5000 mounted and 2000 unmounted native plants with many exchanges; the E. L. Hankensen collection of 2500 plants of Wayne and Monroe counties; Van Ingen collection of 700 plants of Cayuga Lake Basin; R. L. Jughan collection of 280 plants from the same locality; the George T. Fish collection of 1300 mounted, 500 unmounted specimens, all named;

200 western plants from Fred S. Boughton, also many plants from Jamaica. The Dr. Edson collection of 400 mounted, 300 unmounted plants; the Mary Macauley collection consisting of a large number of local plants and collections from Montana, Tennessee, Colorado, Florida, and Nova Scotia; the Florence Beckwith collection of western plants, 900 Colorado, 75 Arizona, 175 California, all identified by Dr. Rydberg; and in addition, a large collection of local plants all identified and mounted; the E. P. Killip collection of about 15,000 specimens; and the extensive collection of M. S. Baxter. Besides these, there have been many smaller donations such as 75 sheets given by Dr. and Mrs. L. R. Cornman, Mrs. F. H. Dennis—100 plants from Florida and elsewhere; Mary Francis Baker, plants and grasses from Florida; the Dewing collection under the label of V. Dewing and reading in many cases M. S. Baxter and V. Dewing; the Mary Streeter colllection; 113 algae presented by George Rafter and hundreds of sheets collected by members of the section. Besides a fairly complete local flora, begun before 1860, it contains representatives from all parts of the world. New plants have been obtained by exchange with other botanists and by donations from friends and members of the Section.

The Herbarium is housed with the University of Rochester in insect-proof cases and so splendidly arranged as to be easily accessible for study. Because of the destruction, scattering and isolation brought by war to the principal scientific collections of the Old World, our own, with every herbarium in America will become more and more valuable. The *Science News Letter* of April 5, 1941 says: "In this confused and abnormal world, the scientific collections in American museums and universities constitute oases in a flaming desert of war."

Field days, or excursions, by members of the Academy and friends have been the source of much pleasure and many additions of rarities to the herbarium. The first field day mentioned in the records was to the hills west of Mt. Hope. ("Among other things *Cypripedium acaule* grew there".) Other nearby locations which have been obliterated by encroachment of the city are the splendid light marsh and woods at the Simpson tract, just off St. Paul Blvd.—opposite Seneca Park. *Habenaria lacera* and *Habenaria clavellata* were there besides other rare flowers, some of which have become extinct in this vicinity. A section bordering Monroe Avenue, parts of the Dugway, the woods about Cobbs Hill, the Dingle by the Eastern Wide Waters (Lake Riley) all sacrificed to the "building booms."

The first Section trip to Bergen Swamp was June, 1882, "and," says the record, "in spite of wet feet and mosquitoes it was very enjoyable." Bergen Swamp is still the Mecca of botanists—still alluring with its promises of a "new find" which it generally delivers. Mud Pond, in Wayne County, Junius Ponds in Seneca County, and farther afield, Duck

Lake, Oneida Lake, the Adirondack Mountains, all are contributing to the unceasing growth of the herbarium.

Besides those whose biographies appear with this paper, we would mention several men and women whose ceaseless zeal and indefatigable efforts did much for the success of the Section. Miss Emma Isle joined the Section the first year and was long one of the workers in both field and study groups. Though unable to attend the meetings, she retains a keen interest in the work. Others who have contributed to the Section are: Mary Frances Baker, by personal work with us, on the occasions of her visits in Rochester, and exchanges and gifts from her home in Winter Park, Florida; Dr. and Mrs. L. R. Cornman, now of Los Angeles, California; Mr. James Laird who, though with us but a short time, endeared himself to every member by his tireless work in the field and his splendid personality; Mr. Ellsworth P. Killip, now a member of the staff of the Smithsonian Institution, Washington, D. C. Mr. Conrad Vollertsen is another of the early workers. As a boy he studied botany in the schools of Hamburg, Germany. Very beautiful are the mounted specimens which he did in those early days. He came to America as a young man, and for many years was designer and developer of some of Rochester's most beautiful gardens. He joined the Botanical Section in its early years and was long a valuable contributing worker, bringing many unusual plants to the meetings, and now, though an octogenarian, is still much interested in the work.

The Botanical Section still meets in the Eastman Building, on the Prince Street Campus of the University of Rochester, on the first and third Mondays of each month. The purpose of this Section is still to give a general knowledge of the plants of this and adjacent vicinities. Collections are made in field, forest and swamp and the material for exhibition and study is brought into the meetings. The greater portion of each evening is given to the systematic examination of the plants and the steps for their identification are traced through the analytical key until their scientific names are found. Rare or unusual specimens are mounted for the herbarium. Names of new stations are added to the list of plants of Monroe County.

At the winter meetings identification of trees and herbaceous plants, by their field characteristics is carried on. At present, the time is divided into three sections: first, minutes of the last meeting and discussions; second, study of trees, following Brown's *Trees of Northeastern United States* and identification of twigs through the analytical key; third, study of some particular order conducted by a member and illustrated by mounted specimens.

The Section is also working in co-operation with the Burroughs-Audubon Nature Club which has generously invited studies of the natural resources of the Conservation Station near Railroad Mills. This tract, of about twenty-five acres, is located on both sides of Irondequoit Creek and includes woods, hillsides, bogs, swamps and sandy knolls. It is an ideal spot for the study of the wild life of the county. A partial catalogue already lists about 500 specimens of native flowers.

The Botanical Section is open to all members of the Rochester Academy of Science and cordially welcomes any one who shares its interest in "plants of this vicinity."

FRED S. BOUGHTON

Fellow of the Academy

Any time from the first sunny day in spring to the snow fall in winter, anywhere in the vicinity of Pittsford, N. Y., in the woods, across the fields, along the roads, you might meet a little man with a basket on his arm and, if you accosted him, most volubly would he tell you he was

Plate III—Fred S. Boughton

a botanist and a mycologist. And, while he was really searching for mushrooms, he "Never passed by a flower without looking at it, especially if it was a rare one—never!"—for this was "Freddie Boughton."

Fred S. Boughton, the son of Seymour and Ella Moselle (Van Bergan) Boughton, was born in Pittsford, N. Y. on Sept. 12, 1859. At seven he started in the "little old stone school house" in Pittsford which he attended until he was twenty. He was a precocious child and early became interested in the three things that were to become the main objectives of his life. In the following manner he tells of the awakening of each of these interests. He says: "One day in our kitchen I had my first sight of a scarlet Lady-bird (a beetle) with a red spot on each wing cover and became very much interested in it. My father, coming in the door, looked at it and told me to take it up carefully and put it out of doors as those little beetles were very useful, destroying many insects, especially aphis. This was my first lesson in entomology. Later I learned to catch and mount butterflies and moths and put them in Riker mounts. With some foreign specimens I was able to acquire I now have quite a large collection."

Of Botany he says: "Many years ago we had an old man living here, by the name of Dr. Bennett, who collected herbs and wild plants for medicinal purposes. He came to see me one day and asked if I would read the description of some of the plant he was doubtful about, as his eyes were failing so that he could not read them himself. He came often and as I read he would explain each one so I understood it thoroughly. I realized I was getting some good lessons in botany. The last time he came he brought me some plants of white, blue and pink hepatica and said: 'Plant them in your yard and they will grow.' They were the beginning of what proved to be the first wild flower garden in Pittsford."

Of his first interest in mushrooms he says: "One day I was in the library of my brother-in-law, Mr. S. G. Crump. I picked up a New York State Report with colored pictures and began to look it over and to wonder if we had anything like them in our woods. Having nothing else to do, I took a small basket and went over into what was known as Sutherland's woods. I found fifteen species of several families. I looked them up, as well as I could, and named two of them. That was the beginning of my mycological career and very pleasant and profitable it has been to me and others as well. I soon began to hear of Dr. Peck, in Albany, who would be glad to name any specimen of mushroom sent to him. Through the years Albany has identified or endorsed my identification of scores of mushrooms for me."

Mr. Boughton was always an eager and interested botanist. He joined the Botany Section in 1911. His first contribution was the rare *Gentiana puberula* which he had found in Bushnell's Basin. It was the first time it had been shown in the Section.

Because of his leisure time Mr. Boughton was able to make many excursions to fields, woods and swamps and brought in, weekly, many flowers and often very rare ones. He visited frequently all the nearby stations and went repeatedly to Mendon Ponds, The Gulf, Mud Pond and Bergen Swamp. He botanized in the Adirondacks, making one climb to the summit of Mt. Marcy. He brought in treasures from Smuggler's Notch, Vt., and in 1915 went to the coast, visiting California, Arizona and other western and southern states and brought back an interesting collection of western flowers.

The height of his experience was a trip to Jamaica with Mr. E. P. Killip, of the Smithsonian Institution. As a boy, Mr. Killip had known Mr. Boughton in Pittsford and maintains it was "Freddie" who first interested him in botany. Knowing how greatly Mr. Boughton would enjoy the trip Mr. Killip urged him to go. In spite of the discomforts with which a sub-tropical jungle trip is bound to be beset, Mr. Boughton surely did enjoy it. No complaint did he make of the excessive humidity, the noxious insects, the hanging snakes, the chattering monkeys, even the little burros, which one was supposed to ride. Nothing diminished the joy and satisfaction of seeing tree ferns, hanging ferns, gold and silver ferns, hanging orchids and air plants, gorgeous butterflies vying in splendor with the birds of brilliant plumage and the rare and beautiful fungi, exquisite in color and form. To him it was a paradise from which he brought home a collection of rare plants and many happy memories.

While Mr. Boughton always retained an active interest in the higher plants, his prime objective became the collection and identification of the fungi. Through intensive study and increasing efforts in the field, he has acquired and identified, or had identified, a large and distinguished collection. So familiar have he and his little basket become that he is popularly known as the Mushroom Man. Many times in the season he has brought two large baskets full to the Section, which he would carefully spread out on the table before him and name and classify each one, voicing an emphatic warning of the poisonous varieties. Occasionally he would say: "It is said to be not poisonous, but I have not tried it."

Mr. Boughton is kindly and considerate especially of children. He has delighted in taking boys on field trips and many a one gained his first knowledge of the natural sciences from these trips.

In spite of the handicap of deafness that thwarted his desire for knowledge, limited his social intercourse and made his a self-centered life, Mr. Bougton has attained a recognized position in his chosen field. His patience in his infirmities and his genial friendliness are felt by all who know him.

MATHEMATICAL ANALYSIS OF THE RELATIVE GROWTH OF ORGANISMS*

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As the study of the relative growth of parts of an organism, or of a part with respect to the whole, has grown in importance in recent years, a number of mathematical techniques have come into use for the description and interpretation of the data, most of them associated with the *allometric* equation (Huxley and Teissier, 1936),

$y = bx^k$ (1), or $\log y = k \log x + \log b$. (2)

Questions have arisen about the application and the meaning of the results obtained. Despite considerable discussion, satisfactory answers to many of the questions have not yet appeared. This paper undertakes a critical review of some of the mathematical treatment from first principles, and indicates some problems not previously discussed. Primary emphasis will be placed on the analytical technique rather than on the biology of growth, although the two cannot be separated except from the viewpoint of convenience.

The allometric equation has been used in a variety of ways (Huxley, 1932; Needham, 1934; Richards, 1935; Teissier, 1934, 1937). When k is positive the equation is a parabola; when negative, a hyperbola. Growth with respect to time may be represented by setting y for the measured size and x for time. The parabola has been found useful to describe the relation between different kinds of measurements. When y is a volume and x is a linear measurement, k is usually nearly 3. Volume (y) has been estimated from a surface measurement (x) taking k as 3/2. When weight (y) is used with a linear dimension (x), k is usually more than 3 and may vary during the course of growth when specific gravity or form of the organism changes.

In discussing the allometric equation it will be convenient to use the substitutions $X = \log x$, $Y = \log y$, $B = \log b$, so that (2) may be written $Y = kX + B$. (3)

LOGICAL STATUS

The allometric equation has been criticized concerning the equivalence of the dimensions in the two members. Needham (1934) for example says, "According to the Theory of Dimensions, the dimensions on the two sides of the relation must be equivalent. In this case, $y = bx^k$, they are so only when $k = 1$, which is comparatively rare. Ordinarily, since x is a mass, x^k cannot be. The equation, therefore, has no true physical meaning, that is to say, no new concept can be deduced from it as it

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stands, in the sense that the concept of acceleration arises from the relation, $mf = a$, between mass, force and acceleration." However Lumer (1939a) has shown that the dimensional inconsistency is made to disappear by assigning to b the dimension $(u)^{1-k}$, u being the unit in which x and y are measured. He shows that this dimension results necessarily when the equation is derived by the elimination of the time variable from pairs of certain special curves of growth.

It is possible to establish the dimension of b for all cases. It is well known that the formula arises from the differential equation

$$\frac{1}{y}\frac{dy}{dt} = \frac{k}{x}\frac{dx}{dt} \quad \text{or} \quad \frac{dy}{y} - \frac{k\,dx}{x} = O$$

which expresses the condition that the relative growth rates of x and y maintain a constant ratio throughout growth. This equation is obviously dimensionally valid; consequently any equation properly derived from it must also be valid. After multiplying through by yx^{-k} the second form becomes $x^{-k}dy - kx^{-k-1}y\,dx = O$. As k is a "pure number" the dimensions of each side of the equation are dependent solely on those of x and y. Thus if the units of x are $(u)^{i}$ and of y are $(v)^{j}$, the dimensions of each side of this equation will be $(u)^{-ik}(v)^{j}$. The expression on the left is an exact differential and can be integrated at once: $x^{-k}y = b$, which is easily seen to be equivalent to (1). Since integration is a process of summation, the dimensions of the integral will be the same as those of the differential, and of course those of b will be the same as those of the left hand side: $(u)^{-ik}(v)^{j}$. Thus if x is in $(cm.)^2$ and y in $(cm.)^3$, b is in $(cm.)^{-2k+3}$. If x is in (gm.) and y in (cm.), b is in $(gm.)^{-k}(cm.)$. If both x and y are in (cm.), b is in $(cm.)^{1-k}$, which is Lumer's result. It is futile to look for biological significance in b which will be different when growth is measured in metric or English units.

Another problem concerning the logical status of the allometric equation is its applicability to growth expressed by a sigmoid curve. Lumer (1937) has discussed the relation between the heterogonic formula and the assumption that the absolute growth curves of x and of y are sigmoid, limiting the discussion principally to the simple autocatalytic, the generalized autocatalytic and the Gompertz function. He demonstrates that if the curves of growth of x and of y are both of a single one of these types, then the allometric formula is not an exact representation of the relative growth relation, though it may give a reasonably good approximation. From these examples he draws the conclusion ". . . it appears that, in general, when the growth of the parts is determinate, the concept of a constant coefficient of growth partition, in the sense of Robb and Huxley, is not valid over the entire growth period. . . ."

While the demonstrations given in Lumer's paper are correct for the cases he considers, and although there are empirical cases showing the types of deviations he predicts, it must not be concluded that the sigmoid growth of both x and y is generally inconsistent with the validity of the heterogonic formula. In fact, it is not difficult to show that whatever be the formula of sigmoid growth followed by one of the variables, it is possible for the growth of the other to be sigmoid as well, and still have the heterogonic formula be exactly valid. Let us suppose that the growth of x is sigmoid for example. That is, dx/dt can be expressed in the form

$$\frac{dx}{dt} = f(x) \quad (4)$$

in which $f(x)$ is a function of x which is small when x is small (usually it is zero when x is zero, or the initial value), which rises to a maximum point, and becomes zero for some finite value, A, of x. Upon integration, this differential equation must yield a relation between x and t which does not allow x to rise above a certain value as t becomes indefinitely great. (Vanishing of the derivative for $x = A$ is a necessary, but not a sufficient condition that x approach a horizontal asymptote; this point has been overlooked in theoretical discussions of sigmoid growth curves.) Let us suppose that the growth of x can be expressed by such a relation, and inquire what must be said of the growth of y if the allometric relation is to hold exactly. Differentiating (1) with respect to t, and substituting from (4)

$$\frac{dy}{dt} = bkx^{k-1}\frac{dx}{dt} = bkx^{k-1}\ f(x) \quad (5)$$

When x is small, $f(x)$ is also small, by hypothesis, and dy/dt is correspondingly small. As $f(x)$ increases toward its maximum, x increases also, and consequently dy/dt must increase as well. As x approaches A, which is by definition a finite value, $f(x)$ approaches zero; consequently dy/dt simultaneously approaches zero. It follows that dy/dt starts from a small value, rises to a maxium, and finally decreases to zero. Further, since x is always finite, y must be also. Consequently we find that the growth of y is sigmoid, the differential equation being (upon substitution in (5))

$$\frac{dy}{dt} = bk\left(\frac{y}{b}\right)^{\frac{k-1}{k}}\ f\left[\left(\frac{y}{b}\right)^{\frac{1}{k}}\right]$$

For example, in the case that x is given by the autocatalytic equation $dx/dt = rx\ (A-x)$, the equation for y becomes

$$dy/dt = kry\left[A - \left(\frac{y}{b}\right)^{\frac{1}{k}}\right]$$

It follows that sigmoid or determinative growth in general is not inconsistent with the allometric equation.

LOGARITHMIC PLOTTING AND CHANGE OF SLOPE

In the analysis of data from studies of the relative growth of organisms the allometric equation has special importance for two reasons. In the first place it is shown on theoretical grounds that if the relative growth rates of x and y, respectively dx/xdt and dy/ydt, have a constant ratio throughout growth, the allometric equation describes the growth exactly and the value of the constant ratio is k. Secondly, when empirical data are plotted on double-logarithmic paper it is often found that they are well represented by a straight line, corresponding to equation (3).

The logarithmic plotting is important in these studies partly because of its use in establishing a criterion for the applicability of the allometric equation, and partly because, whether the plot is linear or not, the slope of the curve at any point represents the ratio of the percentage growth rates at the corresponding instant. (The use of the logarithmic coordinates requires some care as shown by Gray (1929) and others.)

It is not possible to lay down standards categorically for the applicability of the allometric equation. A fit far too inaccurate for one purpose may be quite satisfactory for another. Also, it is frequently true that the state of the science is not sufficiently advanced to deal with all the variations of the data, so that the most useful fit may be one which gives only the general trend. It is important to have some idea of the limits of accuracy of the particular representation chosen, to know the deviations of calculated from observed values, and especially to know whether these deviations are haphazard or systematic. In the case of the allometric equation, when one of the main objects is frequently a study of k as a basis for theorization, it is particularly important to know how well or how poorly the constancy or variation of k can be read from the graph, and what degree of variation is likely to remain unnoticed. Discussion of these points seems to be lacking in the literature.

To comprehend the effectiveness of graphical methods of testing linearity and the constancy of k we may examine a curve of known properties, much as a chemist testing an analytical procedure tries it on a "known" specimen. We may take for our example, $Y=1-\cosh X$, cosh X being the hyperbolic cosine of X. We have chosen this function because it has the useful property that motion a given distance along the curve always changes the slope a given amount. The curve has been drawn in figure 1, and the marked points have been spaced so that the difference in slope between any two adjacent ones is 0.25. The slope varies from 3 in the lower left corner to 0 in the upper right. Although the value of the slope changes in a uniform manner, the effect of the change is not equally obvious in all parts of the curve: the lowest third and the middle third could each be fitted by a straight line as satisfactorily as many curves found in the growth literature, although k decreases from 3.0 to 2.0 in the former and from 2.0 to 1.0 in the latter; in the highest third, however, the same amount of decrease in the slope results in a curvature which is much more obvious.

The curvature, on which the eye largely bases the estimate of linearity, is unfortunately not in direct proportion to rate of change of *slope* as one moves along the curve, though it is proportional to rate of change of *angle* of inclination (Granville, 1911a; Wilson, 1912a). Since the slope is the trigonometric tangent of the angle of inclination, the latter is much more sensitive to changes of a given size in the slope when the curve is nearly horizontal than when it has a steeper inclination. In other words, the sensitivity is greatest when the slope is zero, and decreases continually as the numerical value of the slope becomes greater.

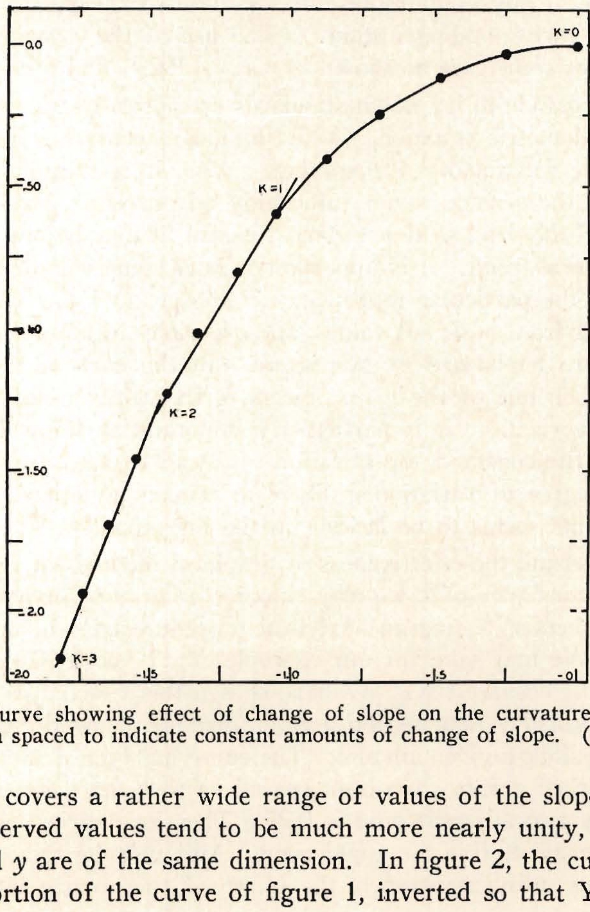

FIGURE 1. Curve showing effect of change of slope on the curvature. The points have been spaced to indicate constant amounts of change of slope. (*Cf.* text.)

Figure 1 covers a rather wide range of values of the slope. In practice the observed values tend to be much more nearly unity, particularly when x and y are of the same dimension. In figure 2, the curve A is an enlarged portion of the curve of figure 1, inverted so that $Y = \cosh X$.

In this figure the slope varies from 0.759 at the lower left to 1.254 at the upper right; this range includes a large part of the observed values of k to be found in the growth literature (*cf.* the tables in Needham, 1934), yet it is quite straight in appearance and can be "fitted" quite well by two straight-line segments! (Points in this curve are not spaced at exactly equal slope-intervals as they were in figure 1.) If it *were not known* that this is a smooth curve with a gradually changing slope it might be accepted with a fit of two straight line segments with a *break* between them. Actual growth curves should be examined by an adequately sensitive test before elaborating on a possible biological significance of a *discontinuity* in the curve, because the apparent break may be due to the size and form of the plot, and the limited acuity of the observer's eye.

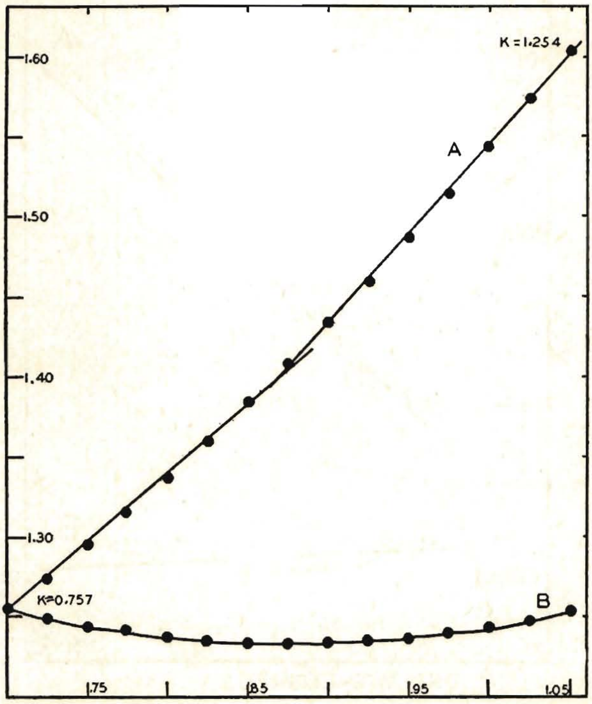

FIGURE 2. A. Apparent "break" in continuous curve. B. Test method shows regularity of curvature.

A method of plotting which is usually more sensitive to variation in k and possesses other advantages consists of plotting the ratio y/x against x on double-logarithmic paper, rather than merely y against x. If k is the slope of the curve at a point in the latter plot, then k–1 will be the slope at the corresponding point in the new plot. Consequently either curve will be a straight line when and only when the other is. However, since the values of k obtained in practice are usually nearly 1, the values of $k-1$ will ordinarily be near zero and the graph is most sensitive to changes in the slope when the slope is nearly zero. (In general, increased sensitivity will result provided k is greater than $\frac{1}{2}$.) As an illustration the ratio curve corresponding to figure 2A is given as 2B. The increased curvature is obvious. Figure 3 is an application to experimental data. Curve 3A is from figure 15 of Needham (1934) depicting the results of Bishop (1929) on lead in the chick embryo against dry weight of the embryo. Curve 3B is the corresponding ratio plot. The lack of constancy of k is much more evident in 3B than in 3A. (A method for plotting is given in the appendix.)

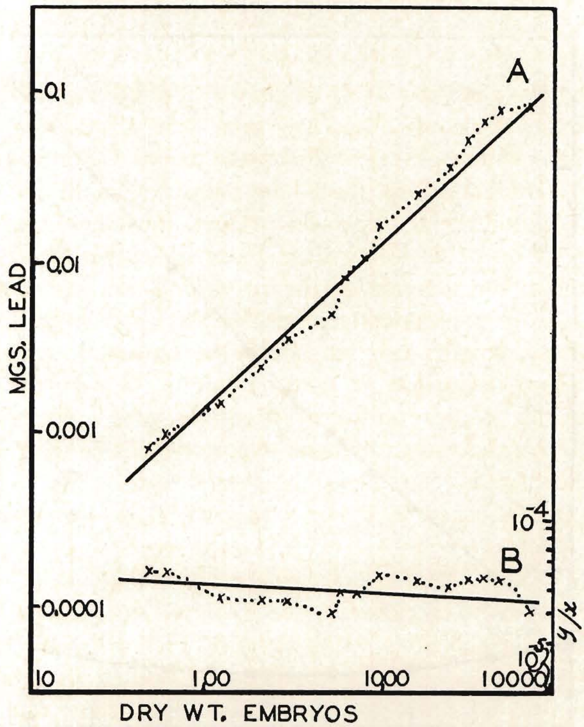

FIGURE 3. Example of test method applied to lead content of chick embryo. From Needham's (1934) Fig. 15. (*Cf.* text.)

Among other characteristics of the ratio-plotting method may be mentioned greater convenience in the analysis of changing proportions during growth. In the conventional plot it is difficult to follow the change in proportions without resort to calculation; in the ratio plot the ratio at any point can be read directly from the graph. Further, deviations of calculated from observed values of Y can be recognized more clearly from the ratio plot (provided k is greater than $\frac{1}{2}$) because though the vertical deviations are the same in the two cases the eye tends to estimate deviations by the perpendicular distance from point to curve rather than by the vertical distance, and these two distances nearly coincide when the curve is nearly horizontal. The value of k is nearly as easily and somewhat more accurately obtained from the ratio plot: it is necessary only to add 1 to the slope obtained from the ratio plot. However, the graph is somewhat misleading if the vertical deviation is not the important one —if for example the perpendicular or horizontal deviation is more important. When the horizontal deviation is more important, it is better to change it into a vertical deviation by reversing x and y and plotting the ratio x/y against y. The slope then is 1/k–1.

SEQUENCES OF DEVIATIONS FROM A CURVE

In estimating the goodness of fit of curves to relative growth data (and much other data) little attention has been paid to the significance of "runs" of points above or below the fitted curve. For a good fit the number of positive deviations should be nearly equal to the number of negative. In addition the arrangement of deviations should be haphazard, as a systematic series of deviations is a strong indication of a fundamental difference between the formula of the curve and the law controlling the observations. It is consequently desirable to know what numbers of "runs" of various lengths can reasonably be expected, a run being an unbroken series of deviations of the same sign. If p be the number of positive deviations, n the number of negatives, and c the total number of deviations, it can be shown that the expectation of runs of r deviations is given by the formula:

$$\frac{np\ (c-r-1)!}{c!}\left[\frac{(n+1)\ (p-1)!}{(p-r)!}+\frac{(p+1)\ (n-1)!}{(n-r)!}\right]$$

The formula was used to calculate the expected frequencies of runs of various lengths in Needham's (1934) figure 1 showing his data on the chick embryo as well as Bishop's analyses of lead in the check embryo used in our figure 3. Both examples show fewer short and more long runs than would be expected on the basis of chance. The systematic manner of deviation indicates a degree of unsatisfactoriness in the formula which was chosen to represent the data.

CLASSES OF DATA AND APPROPRIATE ANALYTICAL METHODS

The ultimate criterion of the desirability of using a given method of curve-fitting is the question of whether its use produces any significant addition to the fund of biological information. More practically, are the labor and expense of calculation justified by the resulting increase in biological knowledge? The determination of what knowledge actually is obtained depends on a thorough understanding of the mathematical principles involved, and a reliable comparison of a number of methods can be made only on the basis of a mathematical study.

The question of fitting the allometric equation to relative growth data has been much discussed and a number of techniques have been suggested, but review of the literature fails to show a logical or systematic development of the subject. Aside from graphical methods some form of the least squares technique is commonest. Much of the difficulty in determining the proper method of application of this technique has come from the fact that the method as originally developed for curve fitting and as ordinarily understood is suited for use only in cases where the error or variation is in one variable alone. In the case of relative growth the deviation of a point from the curve may result from deviation in x, in y or in both. For example in study of the size and shape of the growing clam an individual may be abnormally long, abnormally narrow, or both abnormally long and abnormally narrow. The technique ordinarily employed assumes in effect either that all the clams are of normal length with abnormalities in width only, or *vice versa.* These alternatives yield different curves, and neither gives the same result as the procedure based on error in both variables.

Theoretical justification for the use of the least squares technique, if any exists, arises from the condition that the errors follow the well-known "normal error law." No investigation seems to have been undertaken as to whether the errors in growth studies do follow the normal law. While normal distributions occur in biological material, other forms of distribution are often found. This point should be determined in each case before indulging in lengthy consideration of what variant of the least squares technique is to be used for that case (Yule and Kendall, 1937d). However if the law is satisfied, and the errors are independent of each other, it can be shown that the "best" values of the parameters are those which make a minimum the sum of the ("weighted") squares of the differences between observations and corresponding calculated values. The form of least squares procedure which has ordinarily been used minimizes the sum of the squares of errors in one variable only.

If the least squares procedure is indicated on theoretical grounds, it is necessary to include the squares of errors in both variables. Extension of the theory to the more general case, and the production of an effective technique for its use, are fairly recent. A thorough discussion of the extended technique is given by Deming (1938), including application to the fitting of both forms of the allometric equation. Even the theory as thus augmented is inadequate for one type of relative growth data; the necessary generalization will be discussed later.

The data from most studies on relative growth may be classified in five types. These will be described in turn, and the method of fitting and the significance of the resulting curve will be discussed in each case. It should be emphasized that the exact mathematical course to be followed in a study of relative growth must depend on the biological problem the investigator has set himself, and on the data, experimental or observational, available for the investigation. The first purpose of most growth studies and the principal one of many is the demonstration of an orderly relation, between the elements, structural or chemical, of the growing organism, and the description of the relation in reasonably precise mathematical terms, i. e., by a formula. Knowing the proportionality constants and how well the formula represents the data does not alone answer any biological question. However, the formula may show relations not apparent from reading the table of data and may make possible comparisons essential for the biological analysis of growth. Rather than condemning mathematical anaylsis because it is sometimes inadequately used, it is advantageous for the biologist to perfect the technique and utilize the information thus gained.

Type A.—In this type of data, simultaneous measurements of x and y are made on a single organism from time to time during the course of its growth. The measurements of this organism constitute the entire set. Data of this class are relatively scarce in the literature and can include only measurements made without injuring the organism. Such data are sometimes called longitudinal. Examples are the measurements of Anderson *et al* (1937) on each individual animal (*Daphnia*), and the data on children of the Harvard study used by Shuttleworth (1937). Such a set of data cannot yield the fundamental laws of growth of the species because of the difficulty of distinguishing between the characteristics common to members of the species and those which are peculiar to the individual under study.

At each instant of time each of the quantities x and y has a definite value. That is, in the strictest mathematical sense (Granville, 1911b; Wilson, 1912b) each is a function of the time: $x = f(t)$, $y = g(t)$. These equations may be taken as the parametric equations of a curve, using the word *curve* in the strict sense. Time may be eliminated giving y as a function of x, $y = h(x)$, or *vice versa*. The existence of this curve is evident quite apart from the biological laws producing it, and regardless of the difficulty that may be met in writing down a formula appropriate to describe it. The points are determined by their coordinates and can be plotted; their order on the curve is fixed by the order of the values of t to which they correspond. The curve is continuous, although the slope may vary, and the points (when error of measurement is negligible) *are all exactly on the curve.* Consequently if there is any deviation from the straight-line form in the double logarithmic plot, beyond that ascribable to pure error of measurement, the allometric equation cannot be considered theoretically satisfactory.

If the curve does fit the data within errors of measurement, the fitting process may be carried out by the least squares technique for errors in both variables (Deming, 1938) to obtain the most probable values of b and k. If the curve differs from the data by more than errors of measurement but it is desired to fit the allometric equation for purposes of approximate representation, rough interpolation or determination of an average relative growth rate the choice of method may properly depend on the object. If the resulting curve is to be used to predict values of y which correspond to values of x, the ordinary least squares technique is applicable, since it minimizes the squares of deviations in y. If instead the curve is to be used to predict x in terms of y, the least squares technique should be used which treats as x as the dependent variable. If a treatment symmetrical with respect to x and y is desired the technique for errors in both variables may be used, though the resulting values of the constants lack the theoretical significance they possess when the deviations are ascribable to errors of measurement alone.

In using any form of the least squares technique it is necessary to consider the question of weighting which arises when the logarithmic form (3) is used instead of (1). When the observations follow the normal error law, the justification for use of the least squares procedure is for the equation in form (1). If the logarithmic form (2) is used without weighting the sum of the squares, different results will in general be obtained. The question of weighting for the case of errors in two variables has been considered by Deming (1938) and need not be repeated here.

Feldstein and Hersh (1935) have discussed the question for the treatment of error in one variable, and have pointed out that the difference in results between the two forms of the equation can be eliminated by weighting each observation equation of the logarithmic form with the value of wy^2, the w being the weight of the corresponding equation in the original form. This position is correct, provided the deviations of the observed points from the curve are not too large. However, it is important not to overlook the factor w. On the basis of the principle of least squares it can be shown that the weight w is inversely proportional to the mean square error of y (Leland, 1921). Feldstein and Hersh do not discuss this point, nor is it clear whether the weights w were used in the numerical illustration they give. They were unable to decide whether the weighted or unweighted treatment of the logarithmic form is preferable in relative growth studies.

If the observations follow the normal law and the least squares technique is theoretically necessary, obviously the logically deduced method of weighting is indicated. When the decision must rest on the more empirical basis, it is necessary to keep in mind the nature of the changes brought about by use of the logarithmic form. In the form (1) the effect on the final result of a deviation of given size is the same no matter in what part of the curve it is located. In relative growth studies the large deviations tend to be located at the upper end of the curve, the deviations at the lower end being very small in comparison. Consequently fitting to form (1) (or the wy^2–weighted form (2)), is essentially fitting to the upper end of the curve, the lower end being relatively unimportant. In the unweighted logarithmic form, however, the effect of a deviation of given size in y is proportional to the deviation of log y. Thus a deviation of 10 *per cent* at the lower end of the curve has the same effect as one of 10 *per cent* at the upper, though the latter may be 100 or 1000 times the former in absolute value. Thus the logarithmic method of treatment lays greater emphasis on the lower end of the curve than does the arithmetical. It is interesting to note the effect of the wy^2 weighting as applied to relative growth data. Unfortunately few publications give the mean square errors, but a guess at least can be made from a study of representative graphs. Examination of such a set in Needham (1934) or Teissier (1934) shows that while there are exceptions the tendency is for variation in a logarithmic plot to be no more pronounced in one part of the graph than in another. This is evidence, such as it is, that the w and the y^2 tend to neutralize each other, and there would be little difference between the correctly weighted and the unweighted methods of treatment of the logarithmic form.

When the principal aim of an investigation is a study of the relative growth rate, much more detailed and accurate information can be obtained by the method used by Richards (1935) than from a fit of the allometric equation.

Type B.—A group of individuals is chosen as homogeneous as possible with respect to causative factors, especially age, and one set of measurements is made on each individual. Thus the aspect of growth as a process taking place continually in time is absent; instead we have a study of the variation in size of a group of individuals which have reached a certain stage of development. Such measurements portray relative size rather than relative growth. Sinnott's (1936) investigation of the relation of organ size to tissue development in the stem exemplifies this class. With such data there is no justification for a statement that the observations lie on a curve; there is present no unifying variable such as time to act as a parameter. Neither do observational results justify such a position: to a single value of x may correspond more than one value of y, and *vice versa;* the points obtained cannot be arranged in strict order on any logical basis, though high values of one variable are usually associated with high values of the other so that the plotted points tend to be grouped on the graph into an area which is quite narrow with respect to its length. Nevertheless one reads that the plotted points "lie practically on a curve" and that a curve was "fitted" to the data.

Such a curve can only mark the central tendency, a mean position about which the values vary. The choice will depend on the purpose for which the curve is to be used, much as a similar choice may be made between the median, the mean or the mode for representing the central tendency of a one-variable distribution (Yule and Kendall, 1937a). There can be no question of *the* correct curve to fit the data. Consequently if the allometric equation be used, it is not justifiable to consider the resultant values of b and k as *growth* constants.

The standard methods of correlation naturally suggest themselves for the study of type B data. The fundamentals of correlation technique are described in many textbooks: Yule and Kendall, (1937b); Elderton (1938). The correlation treatment is closely connected with the ordinary least squares treatment, and many considerations are the same in the two techniques. Here, as in type A, it is necessary to distinguish between treatment of the observations (x,y) themselves and treatment of their logarithms (X,Y). For the remainder of this paragraph statements will be made in terms of (x, y); they are also true of (X,Y). The correlation coefficient is useful in determining how close the relation actually is. There are two regression lines and it must be decided from the purpose of the study which one is to be used. One will give the most probable values of y corresponding to given values of x, and the other the most probable values of x corresponding to given values of y. Unless the correlation is perfect $(r = 1)$ these lines will be different. (*Cf.* Weymouth et al, 1925.) Obviously there are no grounds for considering one of these lines as being in general more significant than the other; the illustration of the dimensions of the growing clam given above in the discussion of the least squares treatment is applicable here also. A satisfactory study should calculate both regression lines as well as the coefficient of correlation. A coefficient of 0.90, which is sometimes considered to indicate fairly high correlation, means that the slope of the x-on-y regression line is 23% greater than the value from the y-on-x line. Only when the coefficient of correlation is very high will the two values be substantially the same.[1]

When the correlation study is carried out on (X,Y) rather than on (x,y) the regression lines obtained are precisely those obtained by fitting the logarithmic form (3) to the unweighted logarithmic data by least

[1] The two straight lines given in Fig 1 C′D′ of Richards (1935) should be the same and the equation should be $y = 0.270\ x - 0.02225$. The difference was due to an error of computation and the omission of a large crab from the correlation computation by the student who did the numerical work.

squares for error in one variable only! Thus the fallacy of using one of these lines to the exclusion of the other is again evident.

The assumption is sometimes made that variation from a strict functional relationship in type B data is due principally to advanced or retarded development. While there is some evidence that this condition may be one causative factor, it cannot be accepted as the principal one without careful investigation, and class B data do not furnish the material for such an investigation. If it is found to be true, the situation becomes essentially that of a type D distribution with *biological* time the unknown variant instead of chronological time.

Type C.—This type combines features from both the above types. A number of organisms are chosen, forming as homogeneous a group as possible, and measurements of x and y are made from time to time upon the individuals of the group. When the measuring process harms the organisms different subgroups are measured at each successive period. That is, the complete set of class C data consists of a series of type B distributions arranged in order with respect to time like the successive observations of type A. Examples of this type are the work of Naito (1930, cf. Hamai, 1935) on the growth of Meretrix, and that of Bishop (1929) on the lead content of the embryo of the domestic hen. This kind of data is sometimes called "cross-sectional."

With type A data the principal difficulty was the inability to distinguish between the characteristics of the curve which were common to all members of the species and those which were peculiar to the individual measured. The usual method of treating type C data minimizes this difficulty by taking the arithmetic means $\overline{x}$ and $\overline{y}$ as the best representatives of the group of values at each stage. The successive points $(\overline{x,y})$ then form a curve in the strict sense described for Class A data. This plotted curve is taken as the growth curve of an *average* individual and the properties deduced from it are taken as the growth-characteristics of the species.

While this type of study yields much information it has the disadvantage of possibly obscuring some of the finer characteristics common to the separate curves of the individual organisms. The relation between the curve which fits the average values of a number of sets of measurements and the curve formed from averaging the individual curves has been investigated by Merrill (1931). While her conclusions apply specifically to growth curves with respect to time they may be extended to the present discussion. She states in her summary, "Therefore when observations on any biological form are taken on different individuals of varying ages and the description of growth is given in terms of averages of these observations, the form of growth of these averages cannot be assumed to be characteristic of the growth of the individual organism."

Rarely does the growth of any individual organism follow that of the hypothetical average individual.

Although the definition of the curve of averages is as exact theoretically as that of type A, there is nevertheless the uncertainty introduced by the fact that the data in hand are only a sample of the data which would be obtained from measuring all members of the species. As errors of measurement are usually small in biological work in comparison with errors of sampling, the latter is usually the principal cause of uncertainty in the mean values $\bar{x}$ and $\bar{y}$. On the one hand this uncertainty begets a corresponding uncertainty in the properties of the curve of average growth, an uncertainty which must be measured, allowed for and minimized as far as possible by appropriate statistical procedures. On the other hand it results from and its measures are also in a sense measures of the important natural variation of living organisms. The method of analysis generally used tends to short-circuit this variation.

The favorite method of fitting the allometric equation to type C data has been, as with other types, the least squares procedure for error in one variable, applied to the logarithmic form. Here however, as in type A, there is error in both variables which must be dealt with. Further, as noted above, applicability of the least squares procedure for any number of variables involves the assumption that the errors of observation are independent of each other. In the type C situation the errors in corresponding $\bar{x}$'s and $\bar{y}$'s are not independent, but correlated, for each $(\overline{x,y})$ is derived from a subset of type B in which x and y are usually fairly highly correlated. Hence for a theoretically satisfactory fitting technique it is necessary to take account of the errors in both variables and of the correlation between errors in the pairs (x,y). This more general technique, called "least quadratics" has been worked out (Kavanagh 1941); it proves to be similar in form to the least squares technique. Readers interested should consult this reference after having studied Deming's (1938) multivariate technique.

In cases in which the main aim of the fitting process is the determination of the average value of k during growth there is a simple method of procedure which leads to a value with a definite and easily understood meaning. It is of particular value in cases in which systematic deviations of the data from the allometric form vitiate any attempts at theoretical justification of the "least quadratics" treatment. Average values may be considered either from the statistical or the functional point of view. According to the former, an average is simply a central value intended to indicate the general character of the items it represents. (For a more complete description see Yule and Kendall, 1937c). A functional average of a variable quantity involved in a process is the constant value which could be substituted for the variable throughout the process and produce the same final result from the given initial conditions. (On the derivation of certain types of functional averages see Wilson (1912c).) In the present case the average value of k is to be determined from the formula, $k = (Y_f - Y_i)/(X_f - X_i)$, the subscript i denoting the initial and f the final values. The criticism most likely to be leveled at this formula is that its calculation involves only two of all the observed points along the curve. However the values of k at all points along the curve are involved implicitly in the calculation since the final growth is attained only as the result of the growth at all previous stages. In fact this formula can be obtained as the result of the process of averaging described by Wilson. It is the exact analogue of the method used to determine the average speed of a moving body: distance covered divided by elapsed time.

When the relative growth rate is to be studied more detailed and accurate information can be obtained by the method of Richards (1935) than from fitting the allometric equation.

It should be pointed out that the differences in the values of the constants obtained by the several methods of calculation result from the fact that the observed points do not actually fall on the heterogonic curve, whether because of errors of measurement or sampling, or because of fundamental differences between the law of growth and the allometric equation. If the agreement between observations and equation is very close there will be no appreciable difference in the results of the several methods of fitting.

Type D.—Measurements are made on a group of organisms without regard to the differing stages of development of the individuals; a two-dimensional distribution is made of all the data for study. The study of local variation in the shells of Meretrix by Hamai (1934) illustrates this type, the data from each locality forming a separate type D sample. In data of this sort the variation due to time, characteristic of type A, and that due to individual differences, characteristic of type B, are so intertwined that it is difficult or impossible to separate them. Consequently it is difficult to formulate a rational approach toward treatment of the data or a logical interpretation of the constants derived in fitting the allometric or any other equation to them. Obviously the strict curve relationship between x and y does not exist; usually the correlation kind does. Assuming that it is possible to represent the relation fairly well by a curve (using the word *represent* of course in the sense of giving a central line about which the data vary) there still remains the question of what biological significance to give the representation, and the related question of what is the best method of fitting the curve.

Considered purely as a correlation table the data may be used to predict the value of y most frequently associated with a given x, etc.

However, a difficulty arises here which seems to have been generally overlooked: that arising from uncertainty as to the age-composition of the sample. If clams of a certain age and 3.10 cm. long have an average height of 2.59 cm., while clams 2 months older and the same length have an average height of 2.68 cm., it is obvious the average height corresponding to a length of 3.10 cm. in the sample will depend in part on the relative numbers of clams of those two ages which happen to be included. A similar difficulty is attached to the attempt to determine any of the customary constants from the data. Hamai (1935) for example samples a population of clams at monthly intervals for a year, the data at each sampling forming a distribution of type D. For each samplying he calculated the constants of the allometric equation and assumed them to be growth-constants, i. e., indicative of the nature of growth at the time. He finds variations in the constants from month to month and concludes in effect that these variations can be taken as a measure of the changes in growth activity during the year. Inasmuch as the spawning of these clams occurs mostly during the summer months, it is obvious that there must be a considerable variation in the age-composition of the samples taken over a period of a year. It is equally obvious that any interpretation of the significance of the variation of the constants is open to serious question until the effects of age-variation have been allowed for.

It may be argued that the variation in size at a given age tends to be of the same nature as that in the total population so that, for example, the most probable value of the height corresponding to a given length is the same in each age group as it is in the whole population. However this possibility should not be accepted without statistical verification, which is possible only with type C data. A similar consideration is the dissatisfaction sometimes felt with chronological time as a marker for biological activity, and the resulting belief in the possibility of eliminating much apparent varation by use of appropriate biological states. Thus Anderson and his associates (1937) use instars of Daphnia as time untis. Whatever the limits of chronological time may be, some allowance must be made for the effects of difference in state of development, in *biological time* if a satisfactory one be obtainable, in chronological age if the better measurement be lacking. Type D data make allowance for neither.

If despite the ambiguity of the resulting constants it be desired to fit the allometric equation to type D data choice of method may depend on the purpose of the investigation. The simplest procedure is the least squares fit of (3) for error in one variable only; the variable chosen as dependent being the one whose value it is desired to predict in terms of the other. Attempts to approximate the curve which would be obtained from a type C treatment are hindered at once by absence of knowledge of the distribution with respect to age, or distribution within the separate age groups. The method of least squares for deviations in both variables may be used on either (1) or (2) if it is desired to employ a method symmetrical in its treatment of the two variables.

Type E.—It has been remarked that type A data permit study of the individual but not of the group, while type C data tend to obscure characteristics by the process of averaging. When possible, growth data should be recorded in a manner permitting study of the curves of individuals, and mathematical expressions should be deduced from them to express the common characteristics of these actual curves rather than the curve of a nonexistent "averaged" individual. The work of Anderson, Lumer and Zupancic (1937) previously referred to gives results on the growth of Daphnia individually raised, but their published treatment of the data is mainly of the type C form. In an analogous population problem Richards and Kavanagh (1937) have given a treatment corresponding in some respects to the one proposed here. The averaging of curves has been discussed above and by Merrill (1931). The development of the theory and methods for fitting type E data must await a larger amount of information from experiments and a knowledge of the requirements for the analysis.

TYPICAL PROBLEMS IN ALLOMETRIC GROWTH ANALYSIS

The logical status, problems of fitting and the analyses adapted to the available types of growth data have been discussed. Many of the published studies of allometric growth are incomplete with respect to data or treatment. A detailed review of the literature is not appropriate to the present paper. The relation between the relative growth rates of the parts of an organism and the transformed coordinates of Thompson (1917) has been worked out by the authors and will be published elsewhere.

Brief mention of some of the difficulties and variants of the allometric method is pertinent and the discussion of this section is intended only as constructive criticism aimed to advance the analysis of growth. The papers mentioned are useful contributions even though exception may be taken to them.

Meunier's (1937) contribution fails to mark the units on the ordinates of many of his curves, which precludes any analysis of use of his material. His figures 1 and 2 could be fitted better by curves than by straight lines and there is no evidence given to support the breaks between the lines.

Glaser (1938) has developed a variant form of the allometric equation to express the relation between the age of an animal and the weight of the whole body, or of the various chemical components. This form is $\log w = k \cdot \log(2t+1) + C$, t being measured from the instant of conception or, in the case of the chick, from the beginning of incubation.

That this is essentially the allometric equation is shown by shifting the time origin by means of the substitution $t = t' - \frac{1}{2}$. The equation becomes $\log w = k \cdot \log 2t' + C$, or, $\log w = k \cdot \log t' + C + k \cdot \log 2$, which is the same form as (2), with $w = y$, $t' = x$, and $C + k \cdot \log 2 = \log b$. He derives the formula at first from an empirical fit of the derivative form to the percentage growth rate of the chick, and then endeavors to develop general validity for his treatment of growth problems.

Tests of the adequacy of the formula to represent the data are made (at least in the presentation under discussion) only by visual estimation from graphs. In these graphs there are to be observed many illustrations of the types of questionable use of the equations discussed above. Thus in many cases a curve is *fitted* by segments of two straight lines, although a careful inspection of the plotted points, without regard to the lines, does not reveal any break or angular point justifying such fitting. The most striking examples of this kind of misfitting are his curves 6A, 7D, those of figure 9, 10B, 13B and 13C. In the other cases of this type of fit there is hardly one which does not offer some grounds for challenging the applicability of the method.

Again, in the curves fitted by a single straight line, there is frequently evidence of systematic variation as indicated by "runs" of deviations, curves 1C, 2A and 3E being examples.

In the absence of a priori reasons for expecting this form of the allometric equation to have special validity, it is reasonable to expect a distribution of curves of varying degrees of convexity or concavity, including occasional approximations to linearity. Inspection of the graphs presented in Glaser's paper reveals such a distribution. Figures 3 and 4 present several cases in which there is upward concavity. There are a few examples of linarity, as in figures 1A, 7A, B, C and 8A, and a large number of cases of upward convexity, as in figure 11. It is evident that the graphical evidence tends to refute rather than to support the theory that his form of the allometric equation is a particularly good description of growth. Lerner (1939) has published data which shows that a single linear growth curve is inadequate.

Glaser lays some emphasis on the inclusion of prenatal time in the presentation of data, basing the argument principally on the fact that when this is done the curves, presented on a double-logarithmic graph, tend to *straighten out.* This tendency is a characteristic of double logarithmic presentation of curves of this general type. The straightness could be improved still more by pushing the time origin further back, say to the average birth or hatching date of the mothers of the individuals used in the study. [A modernized preformation theory has been suggested by Glaser (1939).] However, the goodness of fit of theory to observations, as measured by ability to calculate actual weights from the formula, is not in the least improved. This is a characteristic of this type of trans-formation of the time axis which should be borne in mind in attempts to set up a *biological time scale.*

A caution should be urged against the use of unusual methods of treating the data without careful investigation of their implications. A case in point is that of Hersh's (1931) treatment of his data on facet number in bar-eyed stocks of Drosophila. In this treatment y represents the ventral and x the dorsal facet number. Let us consider the treatment of the data for a given stock. All the individuals for whom the sum of the two facet numbers(i. e., $x+y$) lies in the interval 30–39 are put in one group; those for whom the sum lies in the interval 40–49 are put in a second, and so on. The average of the x-values and the average of the y-values in the first group are computed, and the resulting pair (x,y) is taken as the representative of this group. Similar average pairs are computed for each group. The heterogonic equation is then fitted to these *average* points.

In order to understand the implications of this method of treatment, let us imagine the original ungrouped data plotted on ordinary rectangular coordinate paper. We then divide the plane into bands by drawing the lines $x+y=c$ where c takes the values 29.5, 39.5, 49.5, etc. These lines are parallel, and all have the inclination 135° to the x-axis. Then the points which find themselves together in a given band are those which were put in the corresponding group in Hersh's treatment. The exact effect of this method of grouping on the data in question cannot be told without examination of the data. The general nature of the effect can be seen from the following example.

Suppose that the ungrouped distribution can be represented by the law

$$w = ce^{-\frac{1}{2}[(x-a)^2 + (y-b)^2]}, \quad c = \text{a constant},$$

(a, b) being the center of gravity of the distribution. Then x and y are independent, the coefficient of correlation is zero, the regression lines are perpendicular to each other, k for the y–on–x line is zero, and all points a given distance from (a, b) have the same frequency. Now it is easy to see as a result of the symmetry that the average point of each band will lie exactly on the line through the point (a, b) which is perpendicular to the boundary lines of the bands, that is, on the line $x-y=a-b$. Consequently if we fit to the average points we will be treating a distribution in which the coefficient of correlation is 1 instead of 0; the value of k determined for the regression line of y on x will also be 1 instead of the 0 which is the true value! It is obvious that Hersh's results which depend on this method cannot be relied upon to give an accurate picture of the growth situation.

SYSTEMATIC VARIATION IN *k*

Attention has been given to the question of possible relationships between b and k. Thus Hersh observed a relation, $b = Be^{-rk}$, or $\log b = \log B - rk$ in the values obtained from his study of facet number in bar-eyed Drosophila (Hersh, 1931) and again in a study of relative size in various species and genera of the Titanotheres (Hersh, 1934). In this formula, B and r are constants, and e is the base of natural logarithms. He expresses belief that the relation results from the operation of fundamental growth principles, but it is not hard to show that it is due to the mathematical treatment, and in particular to unwarranted extrapolation resulting from choice of the unit of measure. Lumer (1936) pointed out that Hersh's relation is the necessary and sufficient condition that the relative growth curves involved shall all pass through a common point, though in the data under consideration they did not. Later (Lumer, 1939b) he reconsidered the problem and presented a number of hypotheses which would result in such concurrence of the growth curves. These hypotheses are unnecessary, however, in view of the considerations now to be presented.

In a double logarithmic plot of either of Hersh's sets of data which is large enough to include the line $X = 0$ we find the points grouped in a fairly small portion of the plane, because the organs measured were all of roughly comparable size. In particular, the region is fairly small compared with the distance to the line $X = 0$. Now the numerical value of $\log b$ is the value of Y when $X = 0$. Therefore on the one hand the attempt to determine the value of log b from the data represents extrapolation a considerable distance beyond the data. On the other hand, if we do attempt such an extrapolation we have an approximation to Lumer's condition that the lines all pass through the same point. The approximation is of course due to the fact that the size of the region is small *relative* to the distance from the group to the line $X = 0$. Now this distance depends on the unit in which x is measured. The smaller the unit of measure, the further the line is to the left. On the other hand, by taking a larger unit of measure, the line $X = 0$ is moved closer to, or even into the group of points, the degree of extrapolation diminishes and disappears and Hersh's relation vanishes, as can be verified by actual calculation.

This explanation, presented on a somewhat intuitive basis, can be demonstrated rigorously. Let (C,D) be a convenient point within the group of data. By the use of two well-known formulae, one for the "normal" equation of the straight line and the other for the distance from a line to a point (Smith, Gale and Neeley, 1928) the equation can be put in the form $(X-C) \cos w + (Y-D) \sin w + d = 0$, d being the distance from line to (C,D) and w the inclination of the perpendicular from the origin to the line. To find the value of log b, set $X = O$ and simplify: $Y = \log b = D - kC - d/\sin w$, since $k = -\cot w$. Now if d, the distance from the line to the fixed point (C,D) is small in comparison with C, which is the distance from the line $X = O$ to the point (C,D), the term $d/\sin w$ may be neglected, giving $\log b = D - kC$. This is the logarithmic form of Hersh's relation, with $D = \log B$ and $C = r$. Thus if the distances d corresponding to the respective lines are fairly small with respect to C, the several pairs of values of b and k will follow Hersh's relation approximately.

Comparisons of b for different animals were made by Lapicque (1907) long before the present interest in relative growth. He has recently (1937) criticized Meunier and Teissier because he believes that the allometric formula should be reserved for morphological comparisons and not for the description of chemical processes in morphogenesis. The earlier publication of Lapicque compared the size of the brain with that of the body. Systematic variation of b depends on the measuring scales used. Proper chemical comparisons will be difficult and to this extent we may agree with Lapicque. Even in morphology care will be necessary to separate real differences from fortuitous results of the sizes of the measuring scale.

Reeve (1940) has examined the differences b and k for their use as taxonomic criteria. Length of skulls and parts of skulls of three genera of anteaters illustrate his paper. The logarithmic form (2) of the equation was used, because he believes that genetic and environmental differences distribute normally on a logarithmic scale. Correlation methods were used; $k =$ (covariance of x and y)/(variance of x). Formulae are derived for the standard errors of b and k and for testing differences in slope and position of the data following the R. A. Fisher school. The fit of the regression line was tested from the residual variance after fitting a single straight line, separate lines and parallel lines to the samples. The *k's* were different and useful, but the initial growth index (b) values and their errors were not helpful in his analysis. A critical discussion of the errors in this procedure and its advantages as an aid to classification is given.

His data are unequally distributed because most of the specimens available in the museum were fully grown. The *Tamandus* and *Cyclopes* data barely overlap and a series of sizes including more younger stages might change the relations and the interpretations. A single curve would fit the plots of the data on Cartesian coordinates as well and perhaps better than three separate curves. Class D data always limit the interpretation and an evaluation of his tests of significance will become possible when Class B data are available. The paper is an example of the maximum statistical analysis and certainly gives more reason for placing these within one family than in separate families.

Turning to the development viewpoint, it is known that different organs develop at different times and with different rates. The reproductive organs, for example, increase during the pubertal period. The relation of their size to body size would give a low value of k until then, followed by a greater k. Yet the pattern of growth for the individual is logical and consistent. Comparisons of b and k at different stages of development and for different species must be made with caution and consideration of the growth patterns and dimensions involved.

Addenda. Since this was written Needham and Lerner (*Nature,* 1940, 146: 618) also emphasize the difference between comparing by stages or studying the course of relative growth. The former they propose to call allometry and the latter heterauxesis; with adjectives to characterize the kind of each. Later, Huxley, Needham and Lerner (*Nature,* 1941, 148: 25) restore allometry for both cases and recommend allomorphosis for comparisons of parts of organisms of a definite age to wholes or parts at a definite age. It seems to us that rather than changing terms every few years that all conditions should be considered and a simple, uniform and complete terminology proposed. Some further difficulties in this field are illustrated elsewhere (Richards, *Growth,* 1941, 5:171–173).

SUMMARY

A systematic treatment of the problems concerned with the analysis of relative growth by means of the allometric equation, $y = bx^k$, is given, wherein y is a measure of the size of a part and x of the whole organism and b and k are constants. The dimensions of b and k are given, the logical status of the equation is discussed and it is shown to be applicable in the study of sigmoid growth. The problem of fitting the equation directly and by logarithms, the significance of systematic deviations from the fitted curve and an improved method for assessing the constancy of k are described. The available data are grouped in five types and the logical status and proper method for the analysis of the types is given in some detail. More emphasis is given to analytical methods than to biological significance, although the limits of interpretation are stressed. Unusual and variant forms of the allometric equation are criticized.

APPENDIX

Rapid plotting of the ratio y/x against x on double logarithmic paper to investigate the constancy of k may be done by either of the following methods without actually calculating the ratios. (A.) If the points of the y-against-x curve have been plotted, measure with a pair of dividers the horizontal distance from a plotted point to the line $x = 1$; then lay off this distance vertically downward from the given point. The point thus reached will be the corresponding point of the ratio plot. (B.) A drawing board, 45° triangle and a T-square, or a drawing machine are desirable. Locate the value of y on the line $x = 1$. Through this point draw a line with inclination of 135°; its intersection with the vertical line for which x has the given value will be the required point, $(x, y/x)$. This method suggests a simple ruling for a special graph paper for this type of plotting. With either method the line $x = a$, may be used instead of $x = 1$, but if it is desired to estimate the ratios from the graph each value read from the vertical scale must be divided by a.

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A REVIEW OF THE SNAKE GENUS ADELPHICOS[1]

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The present survey of *Adelphicos* has been based upon a study of 92 specimens, distributed among all the five forms of the genus. One subspecies, however, includes two thirds the total number examined. All the material of the genus present in the American Museum of Natural History (AMNH), Academy of Natural Sciences of Philadelphia (ANSP), California Academy of Sciences (CAS),[2] E. H. Taylor-H. M. Smith collection (EHT-HMS), Field Museum of Natural History (FMNH), Museum of Comparative Zoology (MCZ), United States National Museum (USNM) and the University of Michigan Museum of Zoology (UMMZ) has been examined, and to the authorities of these institutions I wish to express my appreciation of their generosity in all respects. In particular I wish to thank Dr. Thomas Barbour, Dr. C. M. Bogert, Dr. Doris Cochran, Dr. E. R. Dunn, Mrs. Helen T. Gaige, Mr. Arthur Loveridge, Mr. K. P. Schmidt, Mr. Benjamin Shreve, Dr. Joseph R. Slevin, Dr. Leonhard Stejneger, Dr. L. C. Stuart, and Dr. E. H. Taylor. Dr. Taylor has very kindly permitted me to describe specimens in his collection. Dr. Stuart has discussed with me many of the problems that have arisen, and has turned over to me much data taken by him. I am indebted to Rozella Smith for the drawings.

This study was completed and a portion of the material on which it is based was secured during tenure of the Walter Rathbone Bacon Traveling Scholarship of the Smithsonian Institution.

Adelphicos Jan

Adelphicos Jan, Arch. Zool., vol. 2, 1862, pp. 18–19; Bocourt, Miss. Sci. Mex., 1883, pp. 553–4; Cope, Bull. U. S. Nat. Mus., no. 32, 1885, p. 85 (*Adelphicus*); *idem,* Trans. Amer. Philos. Soc., vol. 18, 1895, p. 205; *idem,* Ann. Rept. U. S. Nat. Mus. for 1898, 1900, pp. 778, 780; Dunn, Amer. Mus. Nov., no. 314, 1928, pp. 1–2; *idem,* Bull. Antiv. Inst., vol. 2, 1928, p. 23.

Rhegnops Cope, Proc. Acad. Nat. Sci., Phila., 1866, pp. 128–9 (genotype *visoninus,* by monotypy).

Atractus (*part.*) Boulenger, Cat. Snakes Brit. Mus., vol. 2, 1894, p. 300.

Genotype.—Adelphicos quadrivirgatus Jan, by monotypy.

Diagnosis.—Small snakes (maximum total length about 400 mm.) of the family Colubridae, with a relatively short tail (22 to 49 caudals, 121 to 148 ventrals), a small, rather conical head and a moderately stout body; hypapophyses absent on posterior part of vertebral column; hemipenis with an undivided sulcus, a belt of slender spines and tipped

[1] Received for publication, October 27, 1941.
[2] Only 56 of a series of 145 *sargii* examined.

with an area of papillae, in the lower part of which is a small flounce. Anterior chinshields enlarged, in contact with lip or not; seven supralabials normally, 3rd and 4th entering eye; an elongate loreal, entering eye; no preocular; normally two postoculars; temporals 1–1, the posterior typically much longer than broad (fused with a nuchal); nasal divided; rostral very small; head scutellation otherwise typical colubrid.

Scale rows 15 throughout; scales absolutely smooth, pitless; no sexual scale ornaments as chin or supra-anal tubercles; a marked sexual dimorphism in either caudal or ventral counts, or both, the males with the higher caudal and the females with the higher ventral counts.

Nomenclature of scales (See figure 3).—In recording ventral counts it was observed that in *sargii, quadrivirgatus* and *visoninus* almost invariably the first entire ventral is the third scale from the anterior chinshields; accordingly, in order to make all ventral counts in the genus exactly comparable, the third scale from the anterior chinshields was always counted as the first ventral, whether it was divided or not. Anterior to the first ventral, in the three subspecies mentioned, are two transverse rows of three scales; the median scale of each row is here termed the median gular, while the lateral scales are termed lateral gulars. These gulars are almost invariably present and distinguishable, although very frequently the posterior median gular is fused with one of the lateral gulars. Rarely a small, median scale, here termed the pregular, is present between the scales of the posterior pair of chinshields; it appears to be homologous with the median gulars, and indicates that the scales termed the posterior chinshields are juxtaposed lateral gulars.

Accordingly, all specimens regardless of species have one pair of posterior chinshields, rarely separated by a pregular; one row of gulars, the median gulars rarely absent; and a varying number of ventrals, the first one or two of which may be divided into two or three scales. In *verae-pacis* and *nigrilatus* the first ventral is almost always divided, usually into three scales which simulate the rows of gulars; in the other three subspecies the first ventral is seldom divided, and never into three scales. In the first-mentioned two subspecies the gulars are rarely not separated from each other; in the other three subspecies the median posterior gular is fused with one of the lateral gulars in 63 per cent of the specimens.

Pattern.—The dorsal color is light brown to dark gray or brown, extending to the upper edges of the labials on the head and more or less to the ventrals on the body. There are five stripes typically, but the middorsal is frequently nearly or quite obsolete; the lateral stripes may be very broad or nearly indistinguishable; the dorsolateral stripes are the most constant and usually the best defined. In some specimens of *visoninus* all the stripes are poorly defined. The tail may have a middorsal dark stripe, according to subspecies. In one subspecies, the subcaudal surface is unmarked save a longitudinal, median dark line; in several others it is profusely stippled with dark; and in still another both types occur; all have dark markings of some sort under the tail. The belly is immaculate in two subspecies, variable in two, always stippled in one. The gular region and chin is immaculate or spotted, according to subspecies (save in one, in which both types occur).

Dentition.—All teeth are conical, sharply pointed and completely lack grooves. There are 9 to 12 dentary teeth, extending to the extreme posterior tip of the dentary; the teeth are greatly reduced in size posteriorly, and the anterior one or two are slightly smaller than the preceding. There are 9 or 10 maxillary teeth; they are largest near the middle of the maxilla, and strongly decrease in size posteriorly, somewhat anteriorly. There are 7 or 8 palatine teeth, slightly decreasing in size posteriorly. The pterygoid has 12 to 20 teeth extending posteriorly very nearly the full length of the bone; the teeth decrease slightly in size posteriorly; the bone is bluntly pointed or rounded posteriorly, strongly laterally compressed, and about two and one half times as broad (vertically) posteriorly as anteriorly.

Hemipenis.—The hemipenis is large, 11 to 14 caudals long in situ. The sulcus is invariably undivided. A little more than half the proximal portion is smooth and ridged. This is followed distally by an area, about a fourth the length of the hemipenis, of slender, elongate spines varying greatly in size, none conspicuously larger than the others; the larger spines are on the antisulcus side, and the spines decrease in size toward the sulcus; there is no large number of minute spines, but rather these are conspicuously absent, except in *visoninus* (in this they are in an intermediate evolutionary position between the extremes of numerous and of few, all well developed spines). The distal portion of the hemipenis is capped by a papillary area, in which calyces are not discernible; a pocket (flounce) is visible near the base of the papillary area on the antisulcus side.

Generic relationships.—By the possession of an undivided sulcus spermaticus, and by the absence of calyces in the papillate area at the tip of the hemipenis, *Adelphicos* holds a peculiar, isolated position. In other respects—in form, dentition and head scutellation—it resembles *Geophis.* Unfortunately the latter genus has the sulcus divided near the tip of the hemipenis, and calyces are present in the terminal area of papillae. Otherwise the hemipenes of the two genera are similar. In spite of these discrepancies in hemipenial structure in the two genera, all evidence points toward a close relationship between them, and in view of the numerous specializations of *Adelphicos* I conclude that it has been derived from *Geophis* or near ancestors of that genus. In turn, *Geophis* rather obviously has been derived from *Atractus,* a South American genus extending northward only to Panamá. In *Atractus* the hemipenis features a deeply bifurcate sulcus and even a cleft apex. Accordingly well-defined, continuous northward gradients from *Atractus* through *Geophis* to *Adelphicos* are apparent in (1) hemipenial structure (coalescence of the bifurcate elements), in (2) head scutellation (coalescence or loss through reduction in size of various scales), and in (3) body size (*Atractus* largest, *Geophis* intermediate, *Adelphicos* smallest, and primitive *Adelphicos* larger than modified *Adelphicos*). It is apparent that in any natural arrangement of genera into supergeneric groups these three must remain together. With this in mind, it is of interest to test this group against the arrangement proposed by Dunn (Bull. Antiv. Inst. Amer., vol. 2, 1928, pp. 19–24). This arrangement differs from that previously accepted (based on the character of the teeth) by placing emphasis upon the nature of the hemipenis, particularly the sulcus. In this scheme the Colubrinae are characterized chiefly by having a single sulcus, the Xenodontinae by having a divided sulcus. These criteria place *Adelphicos* in the Colubrinae, while *Geophis* and *Atractus* are placed in the Xenodontinae.

The only concept which will allow such a separation of *Adelphicos* from *Geophis* and *Atractus* must propose that all other Colubrine genera have been derived from Adelphicos, and likewise that all other Xenodontinae have been derived from *Geophis*. The idea is of course preposterous, and therefore it must be concluded that at least in this one American genus (*Adelphicos*) a Colubrine type of hemipenis (single sulcus) has been derived independent of other Colubrine genera from the Xenodontine (bifurcate) type of sulcus. If the evolution of the single sulcus has occurred independently once in American Colubrids, very possibly it has occured more than this number of times; just how many can be stated only with a more thorough study of numerous poorly known genera.

In Africa the independent evolution of the single sulcus has occurred many more times than once, as pointed out by Bogert (Bull. Amer. Mus. Nat. Hist., vol. 77, 1940, pp. 7–12). Accordingly, as concluded by Bogert, the nature of the sulcus cannot be considered a character stable in groups of genera as large or as ancient as the category of subfamily. Its use must be confined to groups of lesser size or age, sometimes as small or recent as a single genus (as *Adelphicos*). So far as I am aware, there is no variation in the nature of the sulcus in intra-generic groups or populations.

Obviously some other character or combination of characters must be used to construct a satisfactory subfamily arrangement of the Colubridae. Unfortunately, however, all single characters utilized in the past as subfamily criteria eventually have met with the same objections as are now raised to the hemipenial character. Apparently a successful (completely natural) arrangement must await a more complete study of the phylogeny of Colubrid genera; even then it seems doubtful that single characters will be found that will remain stable and sufficiently well characterize all the genera of their respective subfamilies. The genera will mold the rule, not vice versa, and it appears in this case the rule will be a highly complicated and devious one.

Species relationships.—Two groups are represented in the genus, each composed of a single species, one with two subspecies, the other with three. Group A consists of *v. veraepacis,* and *v. nigrilatus;* group B consists of *quadrivirgatus quadrivirgatus, q. visoninus* and *q. sargii.*

Evolutionary trends can be traced in (1) size of third infralabial; (2) number of palatine and pterygoid teeth; (3) number of hemipenial spines; (4) number of ventrals and caudals; (5) ventral pigmentation of body; (6) subcaudal marks (these independent of belly marks); (7) relative length and width of frontal; (8) and size.

Most significant of all is the size of the chinshields and of the third infralabial, since in these rests the most prominent peculiarity of the genus. Group A obviously shows less modification in this respect than group B, and on the basis of this evidence is assumed, for the sake of convenience, as the more primitive group. A comparison of the two groups, assuming that group A is the more primitive, shows very clearly that the direction of change in the genus are toward (1) reduction in size of the third infralabial, and a corresponding increase in size of the anterior chinshields; (2) increase in number of palatine and pterygoid teeth; (3) reduction in number of hemipenial spines; (4) reduction in number of ventrals and caudals; (5) loss of belly pigment; (6) restriction of subcaudal pigment to a midventral line; (7) shortening and broadening of frontal; (8) and a general decrease in size.

These trends show rather conclusively that *veraepacis* is, as previously assumed, the most primitive member of the genus, and that *nigrilatus* is a direct derivative of it; that *visoninus* represents the next living stage; and from it must have developed *sargii* and *quadrivirgatus;* and that *sargii* is the most highly evolved member of the genus. The accompanying diagram (figure 5) illustrates the relationships of the various species and subspecies.

Distribution.—The genus is restricted to southern Mexico and northern Central America, occurring on Atlantic slopes from central Honduras through British Honduras (apparently not in Yucatán) to central Veracruz (Jicaltepec); and on Pacific slopes from central Guatemala to central Oaxaca (Pochutla). It occurs also in the interior valleys of Guatemala and Chiapas. (See figure 6.)

Key to the Races of Adelphicos

1. Third infralabial nearly as broad as long, subequal in size to second; chinshields not greatly expanded toward lip 2

   Third infralabial absent, or greatly reduced in size and confined to labial border; chinshields greatly expanded toward lip 3

2. Ventrals 124 to 130 in males, 136 to 142 in female; caudals 40 to 42 in males, 27 to 30 in females; maximum length 392 mm. (females; males 358 mm.); chin distinctly dark spotted; all of anterior edges of ventrals dark; subcaudal surface generally suffused with black .... *veraepacis veraepacis*

   Ventrals 121 to 129 in males, 128 to 135 in females; caudals 31 to 37 in males, 22 to 27 in females; maximum length 318 mm. (females; in males 243 mm.); chin nearly or quite immaculate; belly immaculate or with *median* dark spots that do not extend along all of anterior margins of ventrals; a median subcaudal tail stripe .... *veraepacis nigrilatus*

3. Chinshields separated from lip by a very narrow third labial; caudals 43 to 49 in males, 36 to 45 in females; belly frequently heavily pigmented; subcaudal surface frequently suffused with black .... *quadrivirgatus visoninus*

   Chinshields bordering lip, third infralabial absent; belly not or little pigmented 4

4. Caudals 29 to 35 in males, 24 to 29 in females; ground color very dark, lines scarcely visible; never any pigment on chin or belly; subcaudal surface profusely pigmented .... *quadrivirgatus sargii*

   Caudals 44 to 49 in males, 32 to 36 in females; lines on sides and back distinct; belly sometimes with some pigment; a median subcaudal stripe .... *quadrivirgatus quadrivirgatus*

Adelphicos veraepacis veraepacis Stuart

Adelphicos veraepacis Stuart, Occ. Pap. Mus. Zool. Univ. Mich., no. 452, 1941, pp. 5–7.

Type Locality.—Cloud Forest above Finca Samac, seven kilometers west of Cobán, Alta Verapaz, Guatemala. Altitude about 1500 m. Type Mus. Zool. Univ. Mich. No. 89073.

Specimens Examined.—Four.

Diagnosis.—A full complement of seven infralabials; anterior chinshields relatively widely separated from lip; median gulars two, distinct and separate; first ventral divided; ventrals 124 to 130 in males (2), 136 to 142 in females (3); caudals 40 to 42 in males, 27 to 30 in females; frontal distinctly longer than wide; maximum length 392 mm. (in females; males 358 mm.); chin distinctly dark-spotted; all of anterior edges of all ventrals dark.

Dentition.—In No. 89075 there are 9 dentary, 9 maxillary, 7 palatine, and 12 pterygoid teeth.

Hemipenis.—In No. 89074 the hemipenis is eleven caudals long (not everted); the basal five caudal lengths are spineless, ridged; two slender spines, of unequal length, are somewhat larger than others, and are on the antisulcus side; 58 other, smaller spines are present, the smaller ones toward the sulcus side. Flounce (pocket) present.

Variation.—The supralabials are 7–7 except in one, in which the third is split on one side to produce a count of 7–8; the infralabials are regularly 7–7. The preoculars are regularly absent, but the postoculars are variously fused with adjacent scales; in two the lower is fused with the fourth labial on each side, and in one of these the upper postocular is fused with the supraocular. The temporals are regularly 1–1, and the secondary is invariably fused with a nuchal scale, producing a large scale considerably longer than broad. The third labial, loreal and prefrontals regularly enter the eye. The first infralabial is in contact with its mate in all. The posterior chinshields are separated in two, in contact medially in two.

In all the median gulars are distinct, not fused with the lateral gular scales. The first ventral is divided in all, into three scales in two specimens, into two in the other two. There are four entire caudals in one specimen.

The largest female measures 392 mm. in total length, the tail 54 mm. The largest male measures 358 mm. in total length, the tail 6 mm.

TABLE 1.

Scale counts and measurements (in mm.) of A. V. VERAEPACIS.

Number	Sex	Ventrals	Caudals	Length of Frontal	Width of Frontal	Snout
89073	♂	124	40	..	..	..
89074	♂	130	42	3.8	2.8	2.9
89075	♀	136	30	3.8	2.8	2.9
89076	♀	142	28	3.6	2.4	3.2
B472	♀	137	27	2.9	2.3	2.0

In all the general tone is very dark. A very dark brown or black lateral stripe is present in all except one, which shows no evidence of it whatever; in two the stripe involves all of the first and second scale rows, most of the third and the edges of the ventrals; in one its lower edge involves the upper portion of the scales in the first row, while the upper edge involves the lower portion of the fourth scale row. Between the lateral stripes the somewhat lighter ground color generally shows no or irregular evidence of stripes; in the smallest, however (261 mm., total length), narrow dorsolateral dark stripes are present, involving the center of the 6th scale row; it also shows some evidence of a middorsal dark stripe.

The belly is heavily stippled with black or dark brown; the anterior edges of all the ventrals are dark, and near the middle of each ventral the dark color expands posteriorly and nearly or quite reaches the free edge; the expansion of the black areas on each ventral is more pronounced on the posterior part of the belly. The tail is either entirely black, or the middle and posterior edge of each subcaudal is light, the remainder black. The chin is rather strongly marked with black.

Range.—Known only from the type locality, Finca Samac, 7 kilometers west of Cobán (UMMZ 89073), from Finca Chichén, 10 kilometers south of Cobán, Alta Verapaz (UMMZ 89074–6), and Todos Santos, Huehuetenango (UMMZ B472), Guatemala.

Adelphicos veraepacis nigrilatus subsp. nov.

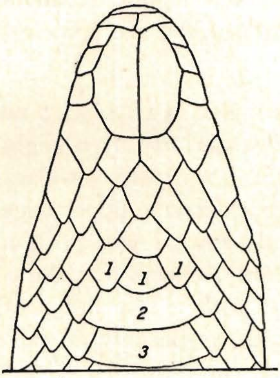
(Figure 1)

Holotype.—EHT-HMS No. 15335, an adult female, from San Cristóbal, Chiapas, collected by H. Devlin Thomas. *Paratypes.*—Eleven. EHT-HMS Nos. 15331–4, 15336–42, all topotypes.

Diagnosis.—A full complement of infralabials, usually seven, seldom eight; anterior chinshields widely separated from lip; median gulars distinct and separate; first ventral generally divided; ventrals 121 to 129 in males, 128 to 135 in females; caudals 31 to 37 in males, 22 to 27 in females; frontal longer than wide (usually distinctly); maximum length 318 mm. (in females; in males 243 mm.); a usually well-defined, dark lateral stripe, and no well-defined markings on the dorsal surface between them; gular region completely immaculate or with very few, small, dark flecks; a median longitudinal subcaudal dark stripe; belly white or with a median dark stripe or series of spots; all of anterior edges of ventrals never black, partly light.

Description of Holotype.—Rostral slightly visible from above; internasals small, a little more than half as wide and a little less than half as long as prefrontals; length of frontal (3.2 mm.) a little greater than its distance from tip of snout (3 mm.) and greater than its own width (2.7 mm.), considerably less than maximum length of parietal (5 mm.), a little greater than length of median parietal suture (3 mm.); sides of frontal convex; supraocular a little wider posteriorly than anteriorly, greatest width (1.3 mm.) slightly less than half width of frontal; nasal completely divided, naris in anterior section; latter very small, deeply wedged between rostral and first labial, about a third size of posterior section; latter rounded, about as high as long; loreal very elongate, narrow, widest posteriorly, its maximum width slightly more than its length, narrowly entering orbit; no preoculars; prefrontal entering orbit; greatest diameter of latter (1.3 mm.) a little greater than its distance from labial border (1.2 mm.); two postoculars, upper a little the larger; temporals 1–1, the second fused with a nuchal scale; supralabials 7–7, 1–2–6–5–3–4–7 in order of increasing size, 3rd and 4th entering orbit, 3rd rather elongate.

Infralabials 7–7, four in contact with chinshields (both first and second pairs, the latter in contact only with 4th labial); first infralabial in contact with its mate medially; anterior chinshields much enlarged, each separated from labial border by about a third its maximum width, their combined width (3 mm.) a little less than their maximum length (3.4 mm.); posterior chinshields small, scale-like, in contact medially; two median gulars and a single pair of lateral gulars; first ventral entire.



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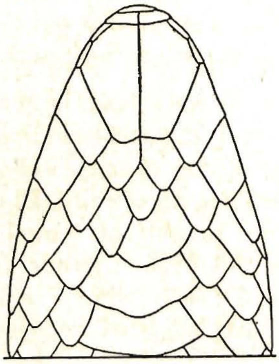

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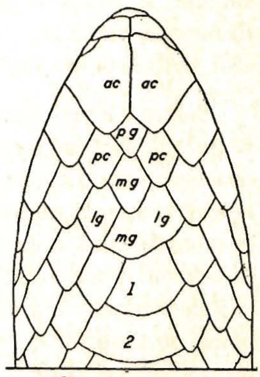

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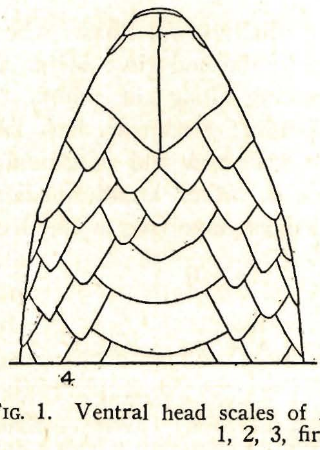

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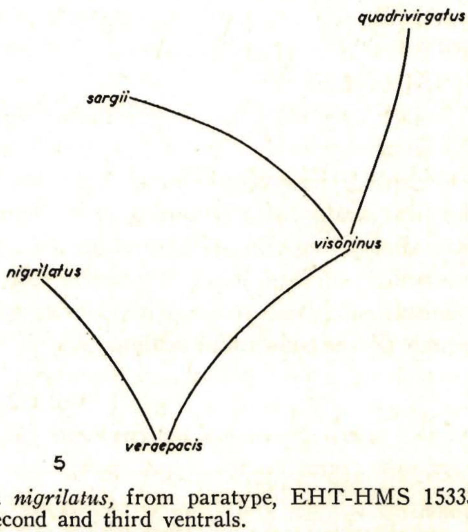

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FIG. 1. Ventral head scales of *A. v. nigrilatus*, from paratype, EHT-HMS 15333. 1, 2, 3, first, second and third ventrals.

FIG. 2. Ventral head scales of *A. q. visoninus*, from MCZ 25893.

FIG. 3. Ventral head scales of *A. q. quadrivirgatus*, from ANSP 11714; *ac*, anterior chinshields; *pc*, posterior chinshields; *pg*, pregular; *mg*, median gular; *lg*, lateral gulars; 1, 2, first and second ventral. The pregular is absent in most specimens.

FIG. 4. Ventral head scales of *A. q. sargii*, from CAS 66843.

FIG. 5. Possible phylogeny of the races of *Adelphicos*.

Ventrals 128; anal divided; caudals 23. Total length 318 mm., tail 38 mm.

Dentition.—No. 15339 has 10 dentary, 10 maxillary, 7 palatine and 14 pterygoid teeth.

Hemipenis.—No. 15333 has a hemipenis 12 caudals long (not everted). There are two large, slender spines of unequal size, somewhat curved at tip, rather conspicuously larger than the others, on antisulcus side; 36 smaller spines are present; the spinose area covers a length of about three and one half caudals; the basal seven caudal lengths are spineless and with longitudinal ridges. Flounce present.

Color.—Upper surface of body light brown, stippled with black; no vertebral dark stripe, except very feebly indicated posteriorly by a slight concentration of stippling; a very distinct, well-defined, uniform, jet-black lateral stripe on body, involving all of third, all except extreme upper edge of fourth, and upper third or half of second scale row; lower portion of second scale row, and all of first, white (cream), except for dark-stippled edges on each scale; belly white (cream), with a few flecks of black on anterior (concealed) edges of some ventrals (especially on posterior part of body).

Head dark slate (almost black) above, this color reaching to and involving upper edges of supralabials and rostral, darker at lower edge; labial border and entire ventral surface of head white (cream), entirely devoid of dark marks.

Tail mostly black above, somewhat lighter medially toward base, where the brown ground color of the dorsal surface of the body is evident; an interrupted, irregularly-edged light line extending along the middle of the first scale row, becoming less distinct distally; a narrow dark line extending along the adjacent edges of the first scale row and subcaudals; subcaudal surface white (cream), except for a rather broad, median, longitudinal black stripe with serrate outer edges, involving a third or fourth of the subcaudal scales.

TABLE 2.

Scale counts and measurements (in mm.) of A. v. NIGRILATUS.

Number	Sex	Ventrals	Caudals	Length of Frontal	Width of Frontal	Snout
15332	♂	126	35	2.1	1.9	1.8
15333	♂	123	31	2.8	2.3	2.2
15336	♂	125	33	2.1	1.9	1.9
15338	♂	129	37	2.5	1.9	1.8
15340	♂	126	31	2.4	2.0	2.1
15342	♂	121	31	2.3	2.2	1.9
15331	♀	135	22	2.5	2.1	2.2
15334	♀	134	27	2.3	1.9	1.9
15335	♀	128	23	3.2	2.8	2.9
15337	♀	130	23	2.3	2.0	1.9
15339	♀	134	24	2.3	2.2	2.2
15341	♀	134	25	2.1	1.9	1.9

Variation.—The supralabials are 7–8 (the anterior section of the third split off on one side), the infralabials 8–8 (the third split on both sides) in one specimen; otherwise both supra- and infralabials are 7–7 in all specimens; they are shaped as in the holotype. In the absence of preoculars and presence of two postoculars there is no variation. The temporals are regularly 1–1, but on one side in two specimens, and on both sides of one, the secondary temporal is not fused with a nuchal; in the others it is fused with one nuchal, producing a single scale longer than broad. The third labial, loreal and preocular enter the eye in all specimens, but in one the loreal is split vertically near the middle on both sides. The first labial is in contact with its mate in all. The posterior chinshields are in contact medially in all.

In all specimens the two median gulars are distinct, not fused with the lateral gular scales. In all except two the first ventral is divided; in six of these the first ventral is divided into three sections, so that there appear to be three succeeding gulars; in four the first ventral is either split in the middle or else the median section is fused with one of the lateral sections. In one specimen, the second ventral also is split (medially). In none are there entire caudals.

The largest female is the type; the largest male measures 243 mm. in total length, the tail 40 mm.

In some specimens there is very faint evidence of dorsolateral or middorsal dark stripes; in general, however, the dorsal surface between the lateral dark lines is practically free of any clearly-defined dark marks. The lateral dark line is well defined in all but one, in which the posteroventral or posterolateral edges of the scales involved by the stripe are light. The stripe involves two complete rows (second and third) and the edges of the adjacent rows in one specimen; in the others it is about as in the holotype, except that the upper edge does not usually involve such a large portion of the fourth scale row.

Invariably a well-defined, median longitudinal dark line is present under the tail; in none is the subcaudal surface diffusely stippled with dark. The amount of black on the belly varies. Some specimens have none, three have a median series of dark spots on the anterior edges of the ventrals, while two have a practically continuous, midventral dark line; the edges of the line are serrate, as the anterior portion of the spot on each ventral is broader than the posterior position. The ventral surface of the head and neck is unmarked, except for a few, very minute, dark flecks near the sutures between the anterior chinshields and infralabials in some specimens.

Comparisons.—The only race of the genus similar to *nigrilatus* is *veraepacis.* These two differ from each other in ventral and caudal counts, ventral coloration and maximum size. Together they form a unit well differentiated from the remainder of the genus: (1) both have broad labials, while others have a very narrow third labial or none; (2) both have a long frontal, distinctly longer than broad, while the others have short frontals, not or very little longer than broad; (3) both invariably have two distinct median gulars, and seldom the first ventral entire, while the others usually have but a single distinct median gular and the first ventral entire; (4) both have a reduced number of dentary (9–10), palatine (7) and pterygoid (12–14) teeth, while the others have 11–12 dentary, 8 palatine and 19–20 pterygoid teeth; (5) and both have numerous spines on the hemipenis (38 to 60), while only *visoninus* (with 52) of the other three has numerous spines.

That *v. nigrilatus* is a derivative of *veraepacis,* rather than the reverse, is indicated in the former by the reduction in ventral and caudal scale counts, loss of chin markings, great reduction of ventral markings, and coalition of the subcaudal pigment to form a single, midventral line. All these modifications are trends away from the primitive condition, as shown by the characters of *sargii* and *quadrivirgatus,* the end forms of the genus.

Adelphicos quadrivirgatus visoninus (Cope)

(Figure 2)

Rhegnops visoninus Cope, Proc. Acad. Nat. Sci. Phila., 1866, pp. 128–9.

Adelphicos quadrivirgatus (?)Müller, Verh. Naturf. Ges. Basel, vol. 7, 1882, p. 142 (Tenosique, Guatemala); Bocourt, Miss. Sci. Mex., 1883, pp. 554–5, pl. 32 fig. 11 (Alta Verapaz); (?)Müller, Verh. Naturf. Ges. Basel, vol. 8, 1887, p. 261 (Guatemala); Günther, Biol. Centr. Amer., 1893, pp. 94–95 (*part.*); (?)Dugès, La Naturaleza, ser. 2, vol. 2, 1894, p. 376 (Tabasco); (?)*idem,* 1896, p. 482; Dunn and Emlen, Proc. Acad. Nat. Sci. Phila., vol. 84, 1932, p. 32 (Carmelina, Honduras); Stuart, Misc. Publ. Univ. Mich. Mus. Zool., no. 29, 1935, p. 51 (La Libertad, Guatemala).

Adelphicos visoninus Cope, Bull. U. S. Nat. Mus., no. 32, 1887, p. 85 (Honduras).

Atractus quadrivirgatus Boulenger, Cat. Snakes Brit. Mus., vol. 2, 1894, pp. 312–3 (*part.;* specimen *c* only, from Honduras); (?)Werner, Verh. Zool. Bot. Ges. Wien, 1896, p. 10 (Guatemala); *idem,* Sitz. Akad. Wiss. Bay., vol. 27, 1897, p. 210 (Guatemala); *idem,* Abh. Akad. Wiss. Berlin, vol. 22, 1903, p. 361 (Guatemala); *idem,* Zool. Jahrb., vol. 57, 1929, p. 161 (*part.*).

Type Locality.—Honduras. Type U. S. Nat. Mus. No. 24899.

Specimens Examined.—Ten.

Diagnosis.—A full complement of infralabials (seven, unless fused together), but the second and third very narrow, barely excluding chin-shields from labial border; ventrals 126 to 129 in two males, 127 to 148 in females; caudals 43 to 49 in two males, 36 to 45 in females; dorsolateral dark stripe involving mainly the fifth row of dorsals, sometimes encroaching on the edges of the fourth and sixth scale rows; no distinct middorsal tail stripe.

Dentition.—In MCZ 32008 there are 11 dentary, 10 maxillary, 8 palatine and 19 pterygoid teeth.

Hemipenis.—In FMNH No. 21880, the hemipenis is 14 caudals long (not everted); the area of spines begins 7 caudal lengths from the base; the last two caudal lengths are covered by papillae; about 52 spines, two a little longer and larger than others, all varying greatly in size; apparently a flounce (pocket).

Variation.—The supralabials and infralabials are 7–7 in all. No preoculars, 2–2 postoculars, and 1–1 temporals in all; in one the secondary temporal is not fused with a nuchal. The loreal is normal, and it, the third labial, the prefrontal enter eye in all. The first infralabial is in contact with its mate in all. The posterior chinshields are separated from each other by a pregular in one. In six there is but one free median gular, the posterior fused with one of the lateral gulars; in three both gulars are free. The first ventral is divided medially in one. There are no entire caudals in any specimen.

The largest specimen (MCZ 32008, female) measures 322 mm. from snout to vent (tail broken).

TABLE 3.

Scale counts and measurements (in mm.) of A. Q. VISONINUS.

Author or Museum	Date or Number	Sex	Ventrals	Caudals	Length of Frontal	Width of Frontal	Snout
USNM	109706	♂	129	49	1.9	1.9	1.7
FMNH	21880	♂	...	44	..	..	..
Boul.	1894	♂ ?	126	43	..	..	..
Werner	1897	♀ ?	139	45	..	..	..
Werner	1903	♀ ?	139	41	..	..	..
USNM	24889	♀	136	36	2.2	2.2	2.2
USNM	62971	♀	127	41	1.9	1.8	1.8
MCZ	25893	♀	142	45	2.8	2.8	2.2
MCZ	32008	♀	140	..	3.1	2.9	2.8
MCZ	38726	♀	134	36	2.0	2.0	2.0
UMMZ	829	♀	141	42	2.3	2.6	2.6
UMMZ	867	♀	141	..	2.2	2.6	2.8
UMMZ	74887	♀	148	37?	2.2	2.3	..

A considerable variation in color occurs. The belly is immaculate in three (Hond.; Carmelina, Hond.; Petén), feebly marked in two (Tela, Hond.; Chiapas), and in the remainder the belly is rather heavily stippled with black (Portillo Grande and Mataderos Mts., Honduras; St. Lucas and La Primavera, Guatemala). In the latter specimens the ventral surface of the tail is irregularly mottled, while in the others a distinct, midventral longitudinal stripe is present on the tail. The lateral dark stripes involve the adjacent edges of the second and third scale rows, or are greatly expanded to include all the second and third, and a portion of the first and fourth scale rows. The dorsolateral dark stripes involve the fifth, and sometimes adjacent portions of the sixth and fourth. The middorsal dark stripe is poorly defined or absent. The tail is irregularly marked above, and lacks a distinct middorsal stripe; the dorsolateral body stripes disappear at about the middle of the tail. The lateral body stripes extend onto the tail and involve the edges of the subcaudals, or in some a narrow light line interrupts the lateral dark line on the middle of the first scale row of dorsals (on tail).

Comparisons.—The present form is a close relative of *quadrivirgatus,* from which it differs in the presence of a narrow third labial separating the chinshields from lip, certain average differences in pattern, and by having numerous spines on the hemipenis. Intergradation with *quadrivirgatus* is assumed on the basis of the "Honduras" specimen of the latter subspecies, in which the color pattern of *visoninus* is closely approached.

That *visoninus* is the most primitive race of its species is indicated by the possession of more numerous spines on the hemipenis; presence of the third labial; variability of the ventral color, some specimens retaining the primitive pigmentation, others having lost it; and the variability of the subcaudal marks, some having diffuse marks as in *veraepacis,* others with a single midventral line as in *q. quadrivirgatus.*

Range.—Foothills on Atlantic slopes from Tabasco south and east to central Honduras.

Locality Records.—(?) *Tabasco* (Dugès, 1896): (?) Tenosique (Müller, 1882; said to be in Guatemala, but I can find no town of such name in that country). *Chiapas:* Palenque (USNM 109706). *Guatemala:* St. Lucas, Sololá (MCZ 25893); La Libertad, Petén (UMMZ 74887); La Primavera, Alta Verapaz (UMMZ 2 spec.). *Honduras:* Carmelina (USNM 62971); Mataderos Mts., 3500 ft. (MCZ 38726); Portillo Grande, Yoro (FMNH 21880); Tela (MCZ 32008); "Honduras" (USNM 24899; Brit. Mus.[3]).

Adelphicos quadrivirgatus quadrivirgatus Jan

(Figure 3)

Rhabdosoma lineatum Günther (*non* Duméril and Bibron), Cat. Snakes Brit. Mus., 1858, p. 11 (Sallé specimen from Mexico); Lichtenstein, Nom. Berol., 1856, p. 23 (*part.*); Müller, Reisen Ver. Staat. Can. Mex., vol. 3, 1865, p. 605 (no specimens; record from Günther).

Adelphicos quadrivirgatum Jan, Arch. Zool., vol. 2, 1862, pp. 18–19, pl. 8; *idem,* Elenco Sist. Ofidi, 1863, p. 32; Jan and Sordelli, Icon. Gén., livr. 11, 1865, pl. 3, fig. 5; Cope, Proc. Amer. Philos. Soc., vol. 22, 1895, p. 381 (Jicaltepec, Veracruz); Ferrari Perez, Proc. U. S. Nat. Mus., vol. 9, 1886, p. 190; Cope, Bull. U. S. Nat. Mus., no. 32, 1887, p. 86; Günther, Biol. Centr. Amer., 1893, pp. 94–95

[3] Schmidt suggests (Zool. Ser. Field Mus. Nat. Hist., vol. 22, 1941, p. 503) that the "Honduras" specimen in the British Museum may be from British Honduras, as are other Dyson specimens. In such case the specimen probably should be referred to *A. q. quadrivirgatus;* data available at present are not sufficient to definitely allocate the specimen without reference to locality.

(*part.*); Cope, Trans. Amer. Philos. Soc., vol. 18, 1895, pl. 21, fig. 9 (hemipenis); *idem*, Ann. Rept. U. S. Nat. Mus., for 1898, 1900, pl. 19, fig. 9 (hemipenis); Dunn, 1932, Copeia, no. 4, p. 163; Taylor, Kans. Univ. Sci. Bull., vol. 26, 1940, pp. 453–5 (*part.*; Ocozucoautla, Chiapas).

Adelphicos quadrivirgatum acutirostrum Bocourt, Miss. Sci. Mex., 1883, p. 555, pl. 32, fig. 12 ("Mexico") (*acutirostris* in explanation of plate).

Atractus quadrivirgatus Boulenger, Cat. Snakes Brit. Mus., vol. 2, 1894, pp. 312–3 (*part.*; only specimen *a*, "Mexico," collected by Sallé); Amaral, Mem. Inst. Butantan, vol. 4, 1929, p. 189 (*part.*); Werner, Zool. Jahrb., vol. 57, 1929, p. 161 (*part.*).

Adelphicos visoninus Schmidt, Zool. Ser. Field Mus. Nat. Hist., vol. 22, 1941, p. 503.

Type Locality.—"Mexico."

Specimens Examined.—Four; only seven known.

Diagnosis.—Chinshields in contact with labial border; no third labial (absent or fused with chinshields), second greatly reduced; ventrals 124 to 136 in males (3), 133 to 142 in females (3); caudals 44 to 49 in two males, 32 to 36 in 2 females; tail with a longitudinal dark streak on under side; belly typically immaculate; chin not or little spotted; four dark lines, the dorsolateral more prominent than the lateral; generally a mid-dorsal dark streak on tail; dorsolateral dark stripe involving mainly the 6th scale row.

Dentition.—In No. 11714, there are 12 dentary, 10 maxillary, 8 palatine and 20 pterygoid teeth.

Hemipenis.—In No. 11714, the hemipenis is eleven caudals long (not everted); the spinous area covers a length equivalent to four caudals; four spines larger than the others; a total of 28 spines, the smaller ones toward sulcus side; tip papillate; a flounce present.

Variation.—The supralabials are 7–7 except in one (No. 19742), which has 6–6 (6th and 7th fused); the infralabials are regularly 6–6. No preoculars, two postoculars and 1–1 temporals in all; on one side in one the secondary temporal is not fused with the upper post-temporal. The loreal is normal, and it, the third labial and prefrontal enter eye in all. The first infralabial is in contact with its mate in all.

In three there is but a single, distinct, median gular and the second is fused with a lateral gular in each; in one there are no median gulars, but the lateral gulars meet on the midventral line; in one a pregular separates the posterior chinshields (No. 11714). In two the first ventral is divided medially. In none are there any entire caudals.

The only adult (No. 11714, male) measures 239 mm. in total length, tail 40 mm.

The three Mexican specimens examined are nearly identical in pattern. A fine dark line is present on the adjacent edges of the first and second scale row; except for this line, and the extreme upper edge of the second scale row, the first two rows are white (cream), like the belly,

TABLE 4.

Scale counts and measurements (in mm.) of A. Q. QUADRIVIRGATUS.

Museum	Number	Sex	Ventrals	Caudals	Length of Frontal	Width of Frontal	Snout
FMNH	794R	♂	124	49	1.9	1.9	1.9
EHT-HMS	5461	♂	136	44	2.1	2.0	1.9
ANSP	11714	♂	131	..	2.3	2.3	2.3
AMNH	19742	♀	138	32	1.7	1.8	1.8
Milan	.....	♀ ?	142	36	..	..	..
Paris	.....	♀ ?	135	32	..	..	..
British	.....	♀	133	35	..	..	..

while dorsally the ground color between the stripes is light brown. The lateral dark stripe occupies the third and edges of adjacent scale rows, but it is split by a median longitudinal, light brown line, or else all except the edges of the scales in the third row are light. A solid, dark brown, dorsolateral stripe occupies the sixth and the edges of the adjacent scale rows. In the Chiapas specimen a narrow middorsal dark stripe is present, although represented near middle of body by a series of spots; in it the middorsal dark tail stripe is formed solely of the middorsal body stripe, and the dorsolateral body stripes disappear at about the middle of the tail. In the other two the middorsal tail stripe (vague in Veracruz specimen) is formed by coalition near the base of the tail of the two dorsolateral body stripes, since there is no middorsal body stripe. In all three there is a narrow lateral tail stripe and a fine dark line along the adjacent edges of the subcaudals and first dorsal caudals. In the Veracruz specimen there are a few dark flecks about the adjacent edges of the anterior chinshields and infralabials; in the other two the ventral surface of the head is unmarked. The belly is completely unspotted in all, and there is a midventral longitudinal dark stripe on the tail. The specimen from British Honduras has a fine dark line along the adjacent edges of the first scale row and the ventrals; the lateral dark stripe occupies the lower portion of the third and upper edge of the second scale rows; the dorsolateral stripes occupy most of the fifth and adjacent edges of the sixth scale rows; a middorsal dark stripe (less intense than the other two) occupies the vertebral scale row; on the tail the middorsal stripe is formed by the vertebral body stripe, while the dorsolateral body stripes disappear on the tail; the center of each ventral scale (except the extreme anterior one) is stippled with black, forming a dim, broken, midventral dark line; otherwise this specimen agrees with the others.

Comparisons.—For reasons stated previously, it is believed that *quadrivirgatus, visoninus* and *sargii* together form a compact group considerably different from that including *veraepacis* and *nigrilatus*.

From members of its own group, *quadrivirgatus* is distinguished largely by (1) absence of the third labial and contact of the anterior chinshields with lip (this character held in common with *sargii*); (2) color pattern, characterized chiefly by (a) presence of a median subcaudal dark stripe; (b) predominance of the dorsolateral body stripes (which form the middorsal tail stripe), and (c) absence of the middorsal body stripe (these characters held in common with some *visoninus*); and (3) ventral and caudal counts (higher than in *sargii,* about the same as in *visoninus*). In pattern this race is the most highly evolved of the genus.

Although *quadrivirgatus* and *visoninus* differ rather widely in number of hemipenial spines, it appears probable that these two subspecies intergrade in the region about the base of the Yucatán peninsula. The British Honduras specimen of *quadrivirgatus,* in external features, is just like *visoninus,* except in the absence of the third labial; the nature of the hemipenis cannot be determined. Further specimens from this area will be of much importance in demonstrating more precisely the region of intergradation of the two races.

There is no very conclusive evidence of intergradation of *sargii* and *quadrivirgatus.*

Remarks.—It is remarkable that the four specimens of *quadrivirgatus* examined are from as many different biotic provinces. This fact suggests the possibility that certain variations occurring in the subspecies may have geographic significance, since each of the four differs from the others in some notable respect. The Veracruz specimen has a pregular and the posterior chinshields separated; the British Honduras specimen has no median gulars; the Oaxaca specimen has the last two supralabials fused into a scale which does not look like a double scale, but rather like a single, large scute; only the Chiapas specimen has no noteworthy peculiarity in scutellation.

There is considerable variation in shape of the head in *visoninus* and *quadrivirgatus;* in both subspecies specimens with conical heads (as in *sargii*) occur, as well as specimens with more flattened, blunt heads. This difference was one which led to the description of *acutirostrum,* but I can find no satisfactory means of segregating two groups on the basis of this character. In applying *acutirostrum* to Mexican specimens, Bocourt was under the erroneous impression that Jan's name *quadrivirgatus* applied to specimens from Alta Verapaz. His figures of *Adelphicos* are vague concerning the character of the third labial; I attribute this not to an intermediate nature of the specimens but rather to imperfect observation, since Bocourt does not mention whether the chinshields actually are in contact with the lip.

Range.—Foothills from central Veracruz on the Atlantic coast and central Oaxaca on the Pacific, to British Honduras on the Atlantic and northern Chiapas on the Pacific.

Locality Records.—The only specific localities known are Jicaltepec, Veracruz (ANSP 11714); Pochutla, Oaxaca (AMNH 19742); Ocozucoautla, Chiapas (EHT-HMS 5461); and Silkgrass Creek, British Honduras (FMNH 794.R).

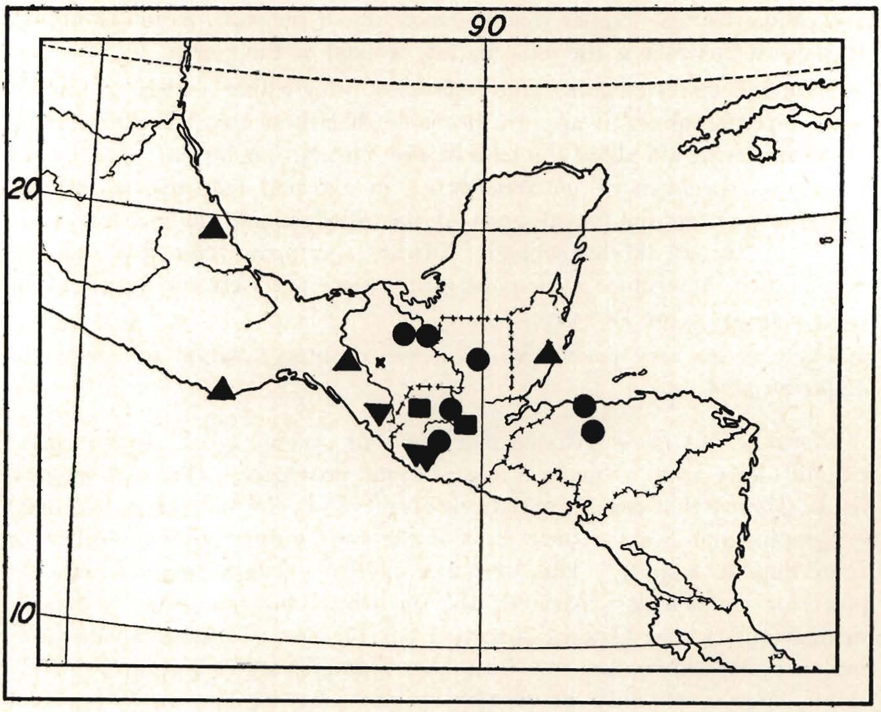

FIG. 6. Distribution of the races of *Adelphicos*. Inverted triangles, *A. q. sargii;* triangles not inverted, *A. q. quadrivirgatus;* dots, *A. q. visoninus;* rectangles, *A. v. veraepacis;* x, *A. v. nigrilatus.*

Adelphicos quadrivirgatus sargii (Fischer)

(Figure 4)

Adelphicos quadrivirgatus Müller, Verh. Naturf. Ges. Basel, vol. 6, 1878, pp. 645–5 (Costa Grande, Guatemala); Günther, Biol. Centr. Amer., 1893, pp. 94–95 (*part.*); Slevin, Proc. Calif. Acad. Sci., ser. 4, vol. 23, 1939, pp. 403–404.

Rhegnops sargii Fischer, Jahrb. Hamb. Wiss. Anst., vol. 2, 1885, pp. 92–93.

Adelphicos sargii Cope, Bull. U. S. Nat. Mus., no. 32, 1887, p. 85.

Atractus quadrivirgatus Boulenger, Cat. Snakes Brit. Mus., vol. 2, 1894, pp. 312–3 (*part.;* specimens *c* and *d,* from Guatemala and an unknown locality).

Type Locality.—Guatemala.

Specimens Examined.—Sixty-two.

Diagnosis.—Anterior chinshields fused with third infralabial, bordering lip; ventrals 125 to 136 in males, 135 to 147 in females; caudals 29 to 35 in males, 24 to 29 in females; ventral surface of body and head always immaculate; subcaudal surface profusely stippled with dark color.

Dentition.—In No. 46514 there are 11 dentary, 10 maxillary, 8 palatine and 19 pterygoid teeth.

Hemipenis.—In the same specimen, the hemipenis is eleven caudals long (not everted); the basal six caudal lengths are spineless, with small, longitudinal ridges; the next three caudal lengths are occupied by six large, slender spines on antisulcus side, and about 20 smaller spines of varying size, extending toward sulcus; tip with papillae and a flounce at base of papillate area, just distal to the larger spines.

Variation.—The supralabials are 6–7 in two (5th and 6th fused on one side), 7–8 in four (3rd split on one side), 7–7 in fifty-six. The infralabials are very variable; in one the chinshields are separated from the lip by a third infralabial, and there is a total of 6–7 infralabials (4th and 5th fused on one side); there are 6–6 labials in 41, 5–6 in 11, 5–5 in 9, and 4–6

TABLE 5.

Ventral and caudal counts of A. Q. SARGII.

Museum	Number	Sex	Ventrals	Caudals	Museum	Number	Sex	Ventrals	Caudals
USNM	46612	♂	130	35	USNM	46514	♀	140	26
USNM	46614	♂	129	30	USNM	46615	♀	137	25
CAS	66727	♂	126	32	MCZ	25216	♀	143	..
CAS	66728	♂	125	30	FMNH	6973	♀	136	29
CAS	66729	♂	128	..	CAS	66725	♀	136	27
CAS	66733	♂	130	31	CAS	66726	♀	137	28
CAS	66738	♂	126	30	CAS	66730	♀	135	27
CAS	66739	♂	129	32	CAS	66731	♀	136	25
CAS	66742	♂	130	32	CAS	66732	♀	139	26
CAS	66743	♂	129	32	CAS	66734	♀	143	29
CAS	66744	♂	129	..	CAS	66735	♀	138	26
CAS	66745	♂	125	33	CAS	66736	♀	140	25
CAS	66746	♂	125	31	CAS	66737	♀	137	27
CAS	66749	♂	125	32	CAS	66740	♀	138	..
CAS	66750	♂	125	35	CAS	66741	♀	138	27
CAS	66751	♂	128	30	CAS	66747	♀	142	25
CAS	66745	♂	129	32	CAS	66748	♀	136	26
CAS	66843	♂	134	33	CAS	66752	♀	135	28
CAS	66846	♂	126	32	CAS	66753	♀	141	28
CAS	66848	♂	133	29	CAS	66844	♀	143	27
CAS	66850	♂	132	33	CAS	66845	♀	145	25
CAS	66851	♂	132	33	CAS	66847	♀	137	28
CAS	66852	♂	136	32	CAS	66849	♀	136	27
CAS	66853	♂	129	30	CAS	66854	♀	138	27
CAS	66857	♂	130	34	CAS	66855	♀	142	28
CAS	66859	♂	129	32	CAS	66856	♀	147	26
CAS	66860	♂	128	..	CAS	66858	♀	138	24
CAS	66861	♂	136	29	CAS	66863	♀	136	24
CAS	66862	♂	129	31	CAS	66865	♀	138	25
CAS	66864	♂	129	32	CAS	66865	♀	137	27
CAS	66867	♂	126	32					
CAS	66868	♂	128	32					

in 1; generally when there is a reduction to 5 the 4th and 5th are fused. There are regularly no preoculars, and the postoculars are 2–2 in all except 2 specimens, in one of which the two are fused together on both sides, while in the other the lower postocular is fused with the 4th labial on one side. The temporals are 1–1 in all; in 8 the secondary temporal is separated from the nuchal on one side, and in 3 this is the condition on both sides. The loreal is split vertically near the middle on one side in 4, on both sides in one; it does not reach the eye in two (both sides). The third labial is separated from the eye in 3 (both sides). The 1st infralabial is in contact with its mate in all but 1. The posterior chinshields are separated medially in two, in which there is a pregular. There are two distinct median gulars in 23, only one distinct gular in 38, and in 1 there are no median gulars (lateral gulars meet on midventral line); in one the posterior gular is fused with both lateral gulars, producing a scale similar in form to the ventrals. The first ventral is split(into two sections) in 16, and the second is split in two. In five specimens there are one to three entire caudals near base of tail.

The largest specimen examined (FMNH 6973, female) measures 309 mm. in total length, the tail 41 mm.

The species is relatively constant in color and pattern. The dorsal ground color is very dark, and the stripes, although present, are greatly obscured, even in young specimens. Most characteristic is the light, unmarked chin and belly. The ventral surface of the tail is heavily stippled, sometimes more heavily near midventral line. The sides of the body are dark, the color involving the edges of the ventrals and the lower part of the third scale row; a dorsolateral dark stripe extends along the adjacent edges of the 4th and 5th scale rows; a middorsal dark stripe is generally present, and in young specimens it can be seen extending nearly to the tip of the tail. The dorsolateral stripes disappear on the tail, and the broad, lateral dark stripes extend nearly to the tip of the tail.

TABLE 6.

Head measurements (in mm.) of A. Q. SARGII.

Museum	Number	Length of Frontal	Width of Frontal	Snout
MCZ	25216	2.4	2.3	2.9
USNM	46612	2.2	2.2	2.2
USNM	46615	1.9	1.8	2.1
USNM	46614	2.0	1.9	2.1
CAS	66856	2.2	2.1	2.1
CAS	66854	2.1	2.1	2.2
CAS	66745	2.2	2.0	2.2
CAS	66857	2.0	1.8	2.0
CAS	66732	2.1	1.8	2.0
CAS	66858	2.2	2.2	2.2
CAS	66751	2.3	2.2	2.2
CAS	66740	2.3	2.1	2.6

Comparisons.—This subspecies is a close relative of *quadrivirgatus,* with which it agrees in all respects except in ventral and caudal counts and in the dark ground color.

Remarks.—While specimens are available from "St. Lucas, Guatemala" of both *visoninus* (MCZ 25893) and *sargii* (MCZ 25216), I do not feel that these locality data are sufficiently exact to warrant supposition that the two forms occur together. This possibility is suggested, however, and places some doubt upon the present arrangement of *sargii, quadrivirgatus* and *visoninus* as subspecies of the same species.

It appears probable that *sargii* was derived from *visoninus* rather than from *quadriviragatus,* since it has retained the primitive subcaudal and dorsal pigmentation. Specimens of *visoninus* from interior regions have the same subcaudal markings as *sargii,* while peripheral specimens resemble *quadrivirgatus* in this respect. In scutellation *sargii* is the most highly evolved race of the genus, and shares with *quadrivirgatus* the complete loss of belly and chin markings.

Range.—Foothills on Pacific slopes from southern Chiapas to central Guatemala.

Locality Records.—*Chiapas:* Chicharras (USNM 46514, 46612, 46614–5). *Guatemala:* Patulul (FMNH 6973); St. Lucas (MCZ 25216); Finca El Ciprés, Volcán Zunil (CAS 66725–66869).

REMARKS ON THE MEXICAN KING SNAKES OF THE TRIANGULUM GROUP[1]

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One of the most intricate herpetological problems in Mexico is the interrelationships and limits of variation of the members of the *triangulum* group of *Lampropeltis*. It is a problem which has received considerable attention, and the fact that a state of some confusion and doubt still exists is perhaps largely due to inadequate locality data for specimens which, with data, would very nearly be sufficient to solve the problems that so far have arisen. Accuracy of locality data cannot be overemphasized; lack of it, and actual misrepresentation of it, have greatly hampered progress toward an understanding of the distribution and status of many forms.

This study has been completed during tenure of the Walter Rathbone Bacon Traveling Scholarship of the Smithsonian Institution.

Lampropeltis triangulum annulata Kennicott

Lampropeltis annulata Kennicott, Proc. Acad. Nat. Sci. Phila., 1860, p. 329 (Matamoras, Tamaulipas).

Lampropeltis triangulum annulata, Blanchard, Bull. U. S. Nat. Mus., no. 114, 1921, pp. 159–164 (*part.*); Taylor, Kans. Univ. Sci. Bull., vol. 26, 1940, p. 466 (Mamulique Pass, Nuevo León).

Diagnosis.—Scales in red areas never black-tipped; snout black, never with light marks; 19 to 26 white rings on body and tail, all complete ventrally; red bands broad, interrupted on belly by broad black areas; belly thus with a series of long, black blotches separated by narow white rings; black rings not confluent dorsally across red areas.

Range.—A lowland-inhabiting subspecies, occurring from extreme southern Texas to central Nuevo León. Presumably intergrades with (or is separated from) *polyzona* in the Tampico area. Intergradation with any other form in Mexico improbable.

Remarks.—Under this name Blanchard confused two distinct subspecies: one of them *annulata* as above diagnosed, the other *arcifera* as below discussed. The latter is represented by the "Puebla" (MCZ) specimen, figured and described in detail by Blanchard, and probably by the "Tehuantepec" specimen (of Boulenger) tentatively referred to *annulata* by Blanchard. Several other specimens, referred to *polyzona* by Blanchard, actually belong to *arcifera,* the characters of which are discussed below. It is here sufficient to remark that *annulata* does not ap-

[1] Received for publication November 21, 1941.

proach it either geographically or in pattern, and that in all probability the two do not directly intergrade.

Lampropeltis triangulum nelsoni Blanchard

Lampropeltis triangulum nelsoni Blanchard, Occ. Papers Mus. Zool. Univ. Mich., no. 81, 1920, p. 6, fig. 1 (Acámbaro, Guanajuato); *idem,* Bull. U. S. Nat. Mus., no. 114, 1921, pp. 155–158, fig. 65 (*part.*); Taylor, Kans. Univ. Sci. Bull., vol. 26, 1940, p. 465 (*part.*).

Diagnosis.—Scales in red areas never black-tipped; snout light, mottled; red, white and black rings complete around body; red rings broad, not enclosed dorsally (a tendency toward the eastern part of range).

Range.—A highland-inhabiting subspecies, occurring from southern Sinaloa to Colima, eastward to eastern Michoacán and eastern Guanajuato. Intergrades with *arcifera* in eastern Michoacán. Intergradation with *blanchardi* in Guerrero indicated; intergradation with *annulata* very improbable.

Remarks.—With the exception of specimens from the Tres Marías Islands (*schmidti*), *nelsoni* of Blanchard is the same as that here considered under that name. He notes, however, that "While the color pat-

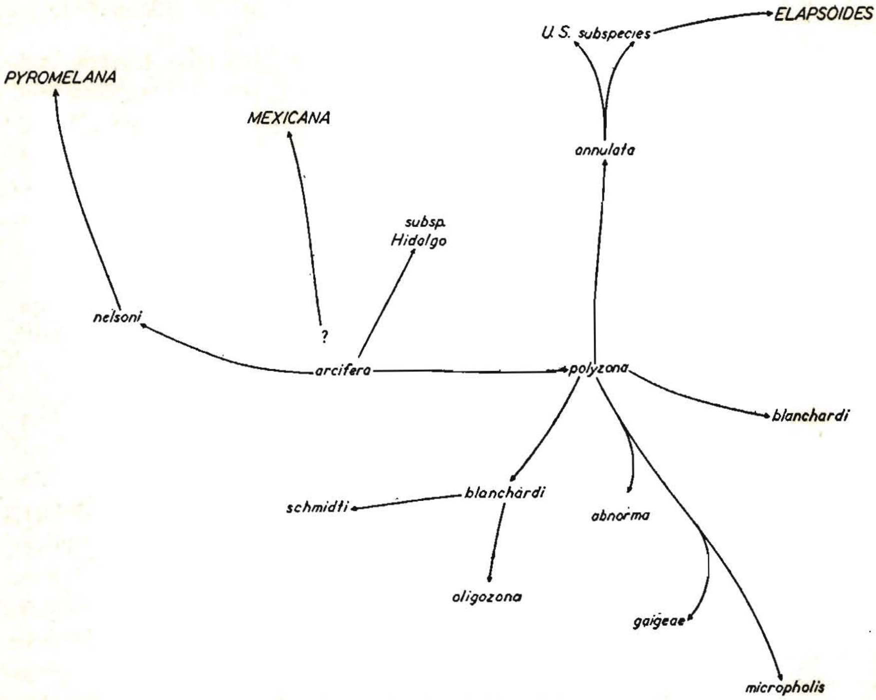

FIGURE 1. Possible phylogeny of the Mexican subspecies of *Lampropeltis triangulum.* Names in capital letters are of subgroups of the *triangulum* group.

tern seems to be constant on the west coast [not the coastal plain], it is very noticeable that toward the interior of Mexico some specimens have the spaces on the belly opposite the dorsal red area partially or completely filled with black, presenting in this a striking approach to *annulata*. The snout, too, may be blacker and the red interspaces between the pairs of black rings may be much narrower and strongly encroached upon by the latter." These tendencies are not toward *annulata*, but toward *arcifera*, a subspecies occupying an adjacent area on the plateau.

It is conceivable that *nelsoni*, with its complete rings, is ancestral to the forms of the *pyromelana* subgroup (see figure 1).

Lampropeltis triangulum arcifera (Werner)

Coronella micropholis arcifera Werner, Zool. Anz., vol. 26, 1903, p. 250 (Mexico).

Coronella micropholis Boulenger, Cat. Snakes Brit. Mus., vol. 2, 1894, p. 205 (*part.*; the "Tehuantepec" specimen).

Lampropeltis polyzona polyzona Blanchard, Bull. U. S. Nat. Mus., no. 114, pp. 139–148, fig. 64 (*part.*; certain specimens from "Mexico," "Orizaba" and "Mirador").

Lampropeltis triangulum annulata Blanchard, *op. cit.*, pp. 159–164 (*part.*; specimen from "Puebla"); Mertens, Abh. Mus. Magdeburg, vol. 6, 1930, p. 160 (Cuautla, Morelos).

Lampropeltis triangulum nelsoni Taylor, Kans. Univ. Sci. Bull., vol. 26, 1940, pp. 465–466 (*part.*; specimen from 15 kilometers west of Morelia, Michoacán).

Diagnosis.—Scales in red areas black-tipped toward the eastern part of range, not toward the western; belly irregularly mottled, or suffused with black, or black areas only opposite red areas; black rings very broad, encroaching upon red areas and sometimes meeting middorsally; red rings seldom longer than a single black ring middorsally; few (usually one) tail bands split with red. (See Plate 1, fig. 1.)

Range.—A highland-inhabiting subspecies, occurring from Morelos and eastern Michoacán eastward to the edge of the plateau in Veracruz, and probably southward toward (not to) Tehuantepec. Intergrades with *nelsoni* and *polyzona*, probably not with *annulata*.

Remarks.—The chief character of this subspecies is the close approximation of the black bands, which frequently meet across the red bands. This peculiarity is found in U.S.N.M. 110823, 30222, from Orizaba (the locality for the former is authentic; it was captured on the city golf links); U.S.N.M. 25012, "Mirador," Veracruz; U.S.N.M. 1854, 32278, no locality; Mus. Comp. Zool. 9555, Puebla (fig. 66, Blanchard); EHT-HMS 15868, 15 km. west of Morelia, Michoacán; a specimen reported by Mertens (*loc. cit.*) from Cuautla, Morelos; and a specimen reported by Boulenger (*loc. cit.*) from "Tehuantepec." These records show a range covering the southern apex of the Mexican plateau. From within this area no other type of pattern has been reported; and from without the *arcifera* type of pattern is mentioned in only one case: by Stuart (Occ. Pap. Mus. Zool. Univ. Mich., no. 309, 1935, p. 3) for MCZ 29242 from Chichen Itza, Yucatán, in which "the black bands expand dorsally to crowd out the intervening pink." These facts leave little doubt of the validity of *arcifera,* and its separation greatly clarifies an understanding of the interrelationships of the Mexican subspecies.

It is possible that *arcifera* may be further split, since extreme eastern specimens have the scales in the red areas black-tipped, while central and western specimens have the scales uniform red. However, because of the existence of these two phases within *arcifera,* I believe this form is a connecting link between the species *polyzona* and *triangulum* of Blanchard, and that it, not *annulata,* is the most primitive of the group. It gives definite evidence that the *triangulum* group originated from a form with simple black and white rings or blotches—obviously some form not greatly different from certain ones in the *getulus* group.

Lampropeltis triangulum blanchardi Stuart

Lampropeltis triangulum blanchardi Stuart, Occ. Papers Mus. Zool. Univ. Mich., no. 309, 1935, pp. 1–6 (Chichen Itza, Yucatán); Taylor, Kans. Univ. Sci. Bull., vol. 26, 1940, p. 467, pl. 49 (El Limoncito, near Acapulco, Guerrero).

Diagnosis.—"Readily distinguishable from *polyzona,* to which it is closest, by the absence of the white snout band, producing an entirely black snout; by its lower average number of ventrals, 208 as compared with 225 in *polyzona;* and by its lower average number of annuli, 25 in *polyzona* and 19 in *blanchardi.*"

Range.—Lowlands of Yucatán and Guerrero. Intergrades with *polyzona,* perhaps with *nelsoni.*

Remarks.—I can see no reason for separation of Guerrero specimens from Yucatán *blanchardi,* in spite of the fact that the former may (not proved) approach *nelsoni.* Both populations of *blanchardi* are pretty obviously derivatives of *polyzona,* and neither is related to the other except through *polyzona.* If the characters of the two populations are the same, however (as they are, for all practical purposes), and they are derived from the same stock (as they definitely are), I see no reason whatever for holding them as different subspecies, although different populations they undoubtedly are. These perhaps are examples of parallel evolution. It is to be noted that an established trend in *polyzona* and its close relatives is decrease in number of bands; this is followed by *annulata, micropholis, and nelsoni,* as well as *blanchardi.*

It is possible that Guerrero *blanchardi* gave rise to *schmidti,* since it, not *nelsoni,* is the adjacent lowland species on the mainland. The fact that *schmidti* lacks dark spots at the tips of the red scales does not necessarily mean that it must be a derivative of *nelsoni,* similar in this character, for there is a very marked tendency in northern and high altitude derivatives of *polyzona* to lose these spots: *annulata* toward the north (and all its derivatives in the U. S.) has lost them, as have *nelsoni* toward the northeast, and high altitude Chiapas and Guatemala *polyzona.* Except for ancestral *polyzona* (more properly, eastern *arcifera*) and *lowland* derivatives *toward the south* (*blanchardi, micropholis*), all derivatives of the *polyzona* stock have lost the spots at the tips of the red scales. It is not likely that *nelsoni,* a highland species, was ever distributed over the lowlands of western Mexico and became established on the land that now forms the Tres Marias Islands; it is much more probable that the island form, *schmidti,* was derived from the lowland race, *blanchardi.*

Lampropeltis triangulum schmidti Stuart

Lampropeltis triangulum schmidti Stuart, Occ. Papers Mus. Zool. Univ. Mich., no. 323, 1935, pp. 1–3 (Tres Marías Islands).

Diagnosis.—"A *Lampropeltis* very similar to *Lampropeltis triangulum nelsoni* from which it may be distinguished by: 1. Greater number of ventrals, 228 to 233 in *schmidti* as compared with 200 to 221 in *nelsoni.* 2. Much wider yellow bands between the black annuli, at least 2½ scales wide in middorsal region in *schmidti* as compared with 1 to 1½ scales wide in *nelsoni.* Conversely the red (in life) spaces between the pairs of black annuli are narrower in *schmidti.* 3. Much lighter snout. 4. Posterior chinshields always separated."

Range.—Restricted to the Tres Marías Islands. Not known to occur on the mainland, although lowland specimens on the mainland may prove the same. Does not intergrade with any form, so far as now known, but apparently is a derivative of *blanchardi.*

Lampropeltis triangulum polyzona Cope

Lampropeltis polyzona Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 258 (Cuatupe, Jalapa, Veracruz).

Diagnosis.—Scales in red areas tipped with black; black rings not encroaching middorsally upon red areas; red rings nearly or quite as long as adjacent triads of black and yellow rings, rarely not at least twice length of a single black ring; usually a white band across top of a black snout; usually white rings closed (black) ventrally; ventrals 208 to 239; annuli 18 to 32.

Range.—Atlantic coastal regions from northern Veracruz into Guatemala, avoiding Yucatán.

Remarks.—The preceding discussion has indicated that Guerrero, Yucatán and all highland specimens from the central plateau of Mexico may be removed from *polyzona polyzona* of Blanchard. Remaining are specimens from the lowland of Veracruz; the lowland of Guatemala and other Central American countries; the Pacific highland of Chiapas; and the Atlantic highland of Guatemala. I cannot see that the *lowland* Veracruz, Guatemala and Honduras specimens differ appreciably from each other; they appear to me to form a unit, approaching the characters of *micropholis* toward the south, as pointed out by Dunn (Occ. Pap. Mus. Zool. Univ. Mich., no. 353, 1937, pp. 3–9). This is the race to which Cope's name *polyzona* is applicable.

The residue of specimens are from foothill zones in two isolated areas: one in southern Chiapas and Guatemala, and the other in the Alta Verapaz area of Guatemala. The latter is in some doubt, since the four specimens inferred to be from that area are labelled simply "Guatemala" (U.S.N.M. No. 6761, three specimens collected by H. Hague, and Field. Mus. Nat. Hist. No. 187). These four are characterized by nearly complete or complete absence of dark tips on the red scales (F.M.N.H. specimen not seen), numerous white rings (29 to 37), and numerous ventrals (225 to 239). These specimens may be considered to represent a direct derivative of an ancient population which north of the Isthmus gave rise to *polyzona*. *Coronella formosa abnorma* Bocourt (Miss. Sci. Mex., Rept., livr. 10, 1886, pl. 39, fig. 4) was proposed for a specimen from this area ("Haute Vera Paz"), but it agrees with the other specimens only in the high ventral count (239, p. 614, under *anomala*). The bands on the body number only 25, and although there is no specific reference to the black tips on the red scales, Bocourt's statement that the coloration is identical with that of *L. polyzona* leads to the inference that the black tips are present. The type very possibly is an intergrade between the typical lowland and the typical highland or foothill race. Since there is no other name which could be used for the highland race, it is suggested that Bocourt's name be restricted to it; the name accordingly should stand as *Lampropeltis triangulum abnorma* (Bocourt). The race may possibly enter Mexico in the ranges of northern Chiapas.

A specimen from Huehuetan, southern Chiapas (U.S.N.M. No. 46439), like those from Guatemala, is characterized by the complete absence of black tips on the red scales, but it is unique in having only 17 white rings (18, minimum in *polyzona sensu strictu*). With it is to be associated U.S.N.M. No. 62210, in which the red scales completely lack tips and the white rings number 16; unfortunately this specimen lacks locality data; it was collected by Sumichrast and therefore may be from some locality east of the Isthmus of Tehuantepec in the mountains of Chiapas or extreme eastern Oaxaca. These specimens seem to represent a well-characterized race which was named *Coronella formosa oligozona* by Bocourt (op. cit., p. 614, pl. 39, fig. 8) on the basis of eight specimens from "Tehuantepec" (Sumichrast) and the western slopes of Guatemala. The figured specimen (from Tehuantepec) lacks black tips on the scales in the red areas, and the description says the body bands vary from 10 to 16, the ventrals from 206 to 227. A brief diagnosis is appended below.

A final color phase represented by specimens available at present is exemplified by U.S.N.M. No. 7103, from "Orizaba" (almost certainly incorrect) and No. 4506, from "Mexico" (collected by Montes de Oca). These specimens are typical *polyzona*, except that the whole belly is suffused with dark color, and is practically uniform black. This condition is indicated in one of two *polyzona* presumably from Tuxpam, Veracruz, and in an *arcifera* from unknown locality. While this may be merely individual variation in *polyzona*, its occurrence in northern specimens, and especially in *arcifera*, leads me to believe it possibly characterizes a form intergrading with *arcifera* and perhaps with *polyzona*. It cannot be a recognizable lowland form, since *annulata* nearly meets *polyzona* (and may actually do so), and since the identifying character occurs in a specimen of the highland *arcifera*. If such a subspecies does exist, therefore, it may be a highland-inhabiting form. It may occur in the eastern mountains of Hidalgo, since no specimens are definitely known from this area. No name is available for it.

Lampropeltis triangulum oligozona (Bocourt)

Coronella formosa oligozona Bocourt, Miss. Sci. Mex., Rept., livr. 10, 1886, pp. 614–615, pl. 39, fig. 8 (in color).

Diagnosis.—Like *t. polyzona*, except: no black tips on scales in red areas (present in *polyzona*); and white rings on body 14 to 17 (18 to 32 in *polyzona*).

Range.—Foothills of southern Guatemala northwestward through the mountains of southern Chiapas to the Isthmus of Tehuantepec.

Lampropeltis mexicana (Garman)

Ophibolus triangulus mexicanus Garman, Mem. Mus. Comp. Zool., vol. 8, 1883, p. 66 (San Luis Postosí, S. L. P.).

Lampropeltis mexicana Blanchard, Bull. U. S. Nat. Mus., no. 114, 1921, pp. 245–247, fig. 77.

This species, one of the rarest of *Lampropeltis*, is now represented in the Museum of Comparative Zoology by twelve specimens, including the two cotypes. The types are from near the city of San Luis Potosí, while the others are from Alvarez, S. L. P. (Nos. 19022–5,[2] 24976–81). The only other known specimen of the species is the type of *Oreophis boulengeri*, now in the Alfredo Dugès Museum in the State College in Guanajuato city. The latter has been examined by me, and in addition, through

[2] These were reported by Loveridge in 1924 (Occ. Papers Bost. Soc. Nat. Hist., vol. 5, pp. 138–139) as *leonis*.

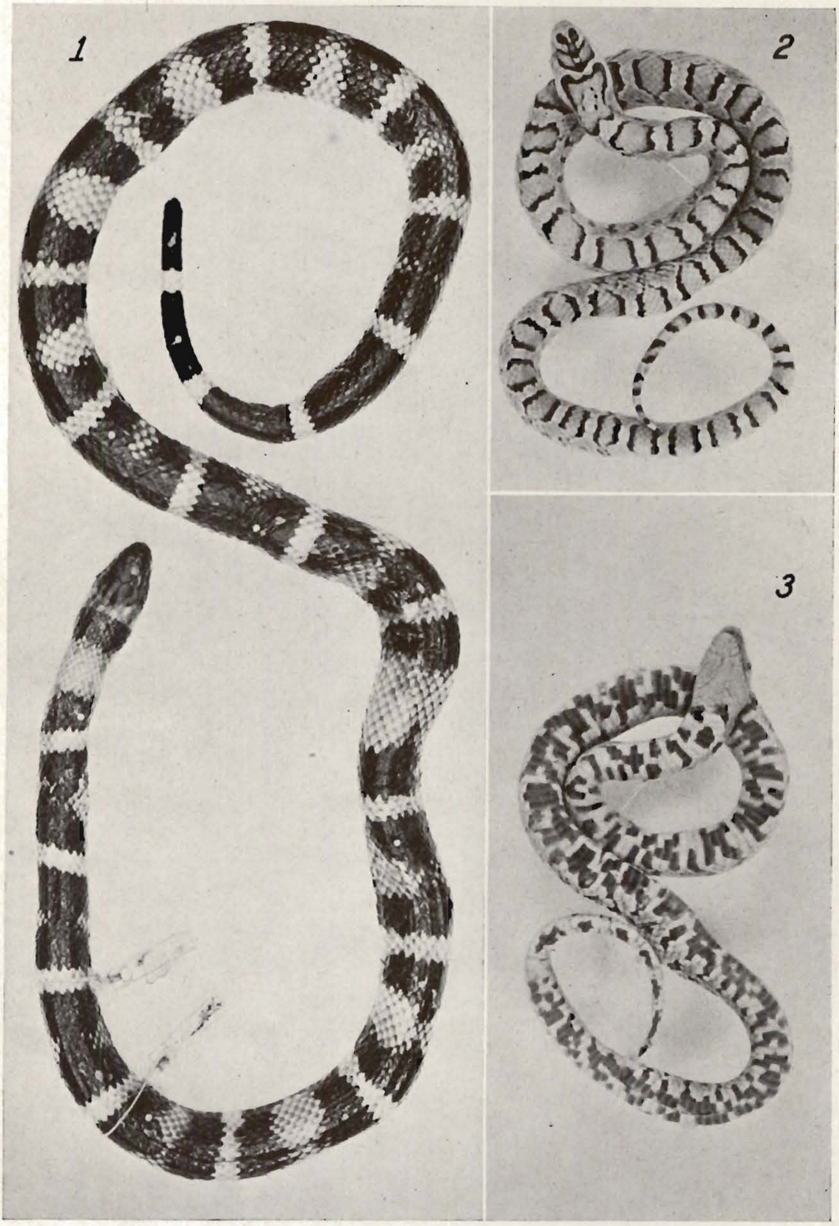

PLATE I

FIGURE 1. *Lampropeltis triangulum arcifera,* dorsal view. From EHT–HMS No. 15868, 15 kilometers west of Morelia, Michoacán.

FIGURE 2. The type of *Oreophis boulengeri,* dorsal view.

FIGURE 3. The type of *Oreophis boulengeri,* ventral view.

the courtesy of Messrs. Loveridge and Shreve, the entire series from Alvarez has been made available to me for study. The following notes on variation are based upon these eleven specimens. (cf. Table 1, p. 207.)

The head patterns of the Alvarez specimens are essentially like that of the type of *Oreophis boulengeri* (plate 1, fig. 2). In none, however, are there two separate extensions of the frontal spot onto the prefrontals, although in several the frontal spot is much enlarged and involves the posterior part of the prefrontals. Usually the black border is incomplete anteriorly when the frontal spot is large. The parietal spots may be fused medially or completely separated (not even the black borders touching) from each other and from the frontal spot. The postocular dark spot is present and well defined in six, absent or poorly defined and small in four.

The nuchal spot is invariably the largest on the body, and usually has a light spot (certainly in seven, possibly in another, absent in two), and occasionally a few other anterior blotches are light-centered.

In one specimen the belly is almost entirely light, with a very few small dark marks toward the sides of the belly. Other specimens show conditions intermediate between this extreme and that represented by the type of *Oreophis boulengeri* (plate 1, fig. 3). The tail is mottled below, and occasionally the dark marks show some tendency toward formation of a midventral line; in none is such a line distinct.

The size of the dorsal blotches varies considerably; they cover from a little less than two to seven and one-half scale lengths; the spaces between them, however, are very constant in size, including one or two scale lengths middorsally. All the tail blotches (except sometimes the extreme distal blotch) are mixed or split with red.

In all specimens measuring 450 mm. or more in total length, the dorsal ground color is heavily suffused with black pigment, except for narrow, irregular areas about the blotches. In smaller specimens the general darkening of the ground color is not obvious, although the same areas show fine, black stippling under the microscope.

Hemipenis of No. 24981 (not everted) about nine caudals long, perhaps very slightly bilobed; extreme distal tip fringed calyces, abruptly grading into an area (equal to the length of about three and one-half caudals) of very small spines; latter somewhat increasing in size toward base, very numerous and closely placed; remainder of hemipenis ridged, each ridge surmounted by a row of widely spaced, extremely minute spicules or spines. Sulcus single.

It is to be noted that the hemipenial characters of this species definitely place it with the *triangulum* group, to which it is similar in essential features of the color pattern.

Lampropeltis alterna (Brown)

Ophibolus alterna Brown, Proc. Acad. Nat. Sci. Phila., 1901 (issued 1902), p. 612, pl. 34 (Davis Mts., Jeff Davis Co., Texas).

Lampropeltis alterna Stejneger and Barbour, Check List N. Amer. Amph. Rept., 1917, p. 87.

A male specimen of *alterna* collected by Mrs. Smith and myself near Saltillo, Coahuila (U.S.N.M. 110819) has a hemipenis typical of the *triangulum* group. It is about seven caudals long; the extreme distal portion is covered by fringed calyces, which grade into an area, reaching to middle of organ, of very numerous, small, straight spines slightly increasing in size proximally.

These hemipenial characters indicate that *mexicana* and *alterna* are more closely related *inter se* and to *triangulum* and *pyromelana* (with their immediate relatives) than any of these is to *elapsoides,* which Blanchard was able to place without question in the *triangulum* group. The chief hemipenial differences of *elapsoides* from the other members of the *triangulum* group are (1) the greater extension of the spinous area toward the base of the organ, and (2) decrease proximally in the size of the spines. In other members of the *triangulum* group the spines reach only to the middle of the hemipenis, and they gradually increase in size proximally.

Accordingly, there is less reason to entertain the idea that *alterna* should not be included in *Lampropeltis* than there is for *elapsoides,* so far as indicated by hemipenial characters. It certainly is closer to *triangulum* than to any member of other groups of the genus, since all others have few, hooked spines on the hemipenis, and the calyces are not fringed. Moreover, it appears that *alterna* may have been derived from *mexicana.* It is apparent that its peculiar pattern, with red in the alternate black bands, rather than in all the black bands as in other members of the group, has been brought about by an antero-posterior contraction of the black bands, carried to such an extreme that only about half the black bands remain with red. Usually these are alternating bands, but not always, for sometimes the "secondary" black bands also have red, as shown by both Murray's specimen from the Chisos Mts. (Contr. Baylor Univ. Mus., no. 24, 1939, pp. 9–12, figs.) and my own from Saltillo. In the former "some of the narrow bands on the anterior portion of the snake are bordered by red," while in the latter several of the posterior bands are split with red. It is apparent that only by mere coincidence did the type specimen of *alterna* have only the alternate bands split with red.

It is obvious that *alterna* must have been derived from a form having many bands, all split with red; from a form with a dark-pigmented ground color; and from one with a tendency toward elimination of head markings. *Lampropeltis mexicana* fits these requirements. There is in that species a tendency toward multiplication of the bands; the head markings tend to be restricted to three spots (frontal, two parietal); and the ground color obviously tends to be very dark in adults.

An essential link in the *mexicana-alterna* chain is *leonis,* a species known only from the type ("Nuevo León") in the British Museum (well figured by Günther, Biol. Centr. Amer., 1893; pl. 39, fig. A). This species was placed by Blanchard in the *calligaster* group, but it cannot belong there.

In evolution of head pattern, *leonis* exhibits a condition intermediate between that of *mexicanus* and *alterna;* the basic three-spot pattern of the former is shown, but a great reduction in the size of each spot demonstrates a reduction trend which in *alterna* reaches its extreme.

In evolution of nuchal pattern also, *leonis* is intermediate. It shows a reduced, but elongate nuchal blotch, partially split medially, obviously derived by reduction from the type exhibited by *mexicana.* In *alterna* (Saltillo specimen) the blotch is still further reduced to two, elongate, lateral spots in exactly the same position as their counterparts in *mexicana* and *leonis.*

In body pattern *alterna* is intermediate between the other two. It retains almost exactly the usual belly color of *mexicana* (mottled). In *leonis* the pattern is greatly reduced, beyond the condition found in *alterna:* most of the dark ventral marks are eliminated, and on the subcaudal surface there remains only a median longitudinal stripe; scarcely any of the narrower, black bands remain on the dorsal surface, there being only the widely spaced, narrow, red bands bordered with black; the narrower bands, corresponding to those of *alterna,* are mostly reduced to a small, lateral spot, and only one or two remain visible as bands; finally, the lateral extensions of the bands split with red are eliminated.

All three species exhibit a darkened ground color, characteristic of their own subgroup.

It appears, therefore, that *leonis* and *alterna* were derived from a form or forms much like *mexicana.* In the evolution of these species the blotches were increased somewhat in number, from that occurring in *mexicana,* until a considerable crowding of them occurred (as is shown on certain parts of the body in some *mexicana*). As the tendency is to retain a certain distance between blotches, regardless of number, some of them of necessity were so narrow the red was eliminated from them. As in many other groups of snakes, this multiplication in number of spots was the forerunner of general pattern reduction, and not only did certain blotches or bands lose their red, but all of them then were constricted antero-posteriorly. At the same time the head pattern was being reduced. *L. alterna* and *leonis* evolved no further in common (or along parallel paths), but were separated at about this stage. In the former the reduction of head pattern became complete, but change in body pattern was slowed. In *leonis* the reverse was true. The trend is toward a unicolor snake, nearly approached in *leonis*.

The peculiar method of pattern reduction in the *mexicana* subgroup—by elimination of alternate blotches—is remarkably similar to that apparent in the *biscutatus* group of *Trimorphodon*, in which *quadruplex*, a forms with numerous, subdivided blotches, gives rise to *biscutatus*, a form with about half the complement of the former. In each case suppression of alternate blotches is evident. The same procedure is indicated in the evolution of certain other end forms of *Trimorphodon*, although the evidence is not so complete as in the described cases. Apparently, then, this may be one of the more frequent methods of pattern reduction in snakes.

It appears that *mexicana* and its two relatives form a subgroup in the *triangulum* group, comparable to the *elapsoides* and *pyromelana* subgroups. The arrangement of the subgroups accordingly is as follows:

triangulum subgroup
- t. arcifera
- t. abnorma
- t. blanchardi
- t. schmidti
- t. oligozona
- t. gaigeae
- t. micropholis

- t. nelsoni

- t. annulata
- t. gentilis
- t. amaura
- t. syspila
- t. triangulum
- t. temporalis

elapsoides subgroup
- e. elapsoides
- e. virginiana

pyromelana subgroup
- thayeri

- ruthveni
- knoblochi
- zonata
- pyromelana

mexicana subgroup
- mexicana
- leonis
- alterna

KEY TO MEXICAN LAMPROPELTIS

1. Pattern of narrow crossbands of black, the alternate bands mixed or split with red .... *alterna*
   Not so 2
2. Pattern without red, of two colors (black or brown, and white) 3
   Pattern with red, of three colors 4
3. Light crossbands separating broader dark rings which are unmarked with white on the dorsal scales .... *getulus yumensis*
   Light crossbands absent or, if present, separating narrow dark blotches which do not reach the ventral scales; lateral scales white-centered .... *getulus splendida*
4. A zigzag lateral white line on third and fourth scale rows; red bands (blotches) numerous (70 in types), only a few broken medially by contact of adjacent black borders .... *knoblochi*
   No such lateral line; red bands (blotches) rarely so numerous, and when about 70, most are broken medially by contact of adjacent black borders 5
5. Pattern of dark-edged dorsal blotches of red 6
   Pattern in rings 7
6. No markings on sides of body; blotches on body 27; separated from each other by twice (or more) their own length, areas between covering four to seven scale lengths .... *leonis*
   Irregular dark markings on sides of body; blotches on body 31 to 47, the spaces between covering one to one and one half scale lengths (less than the length of a single blotch) .... *mexicana*

7. White rings or crossbands on body and tail more than 40 .... *pyromelana*
   White rings less than 40 8
8. Scales in red areas black tipped 9
   Scales in red areas not black tipped 12
9. Red rings narrowed middorsally by expansion of the black rings, which sometimes meet across red areas; latter seldom longer than a single black ring middorsally .... *triangulum arcifera*
   Red rings not distinctly narrowed middorsally, longer middorsally than black rings 10
10. Whole belly suffused with black .... *triangulum* subsp. (Hidalgo?)
    White bands usually interrupted ventrally, black bands complete; belly sometimes mottled, but not wholly suffused with black 11
11. Ventrals 208 to 239, usually 220 or more; white annuli on body and tail 18 to 35, usually 21 or more .... *triangulum polyzona*
    Ventrals 203 to 219; annuli on body and tail 17 to 22, usually 20 or less ...... *triangulum blanchardi*
12. Red rings narrowed middorsally by expansion of the black rings, which sometimes meet across red areas; latter seldom longer than a single black ring middorsally .... *triangulum arcifera*
    Red rings not distinctly narrowed middorsally, longer than black rings 13
13. Red bands interrupted on belly by broad black areas connecting the black rings, white rings complete about body .... *triangulum annulata*
    Red bands not interrupted completely; white rings complete or interrupted .. 14
14. Head uniform black to tips of parietals; white rings on body and tail 30 ...... *ruthveni*
    Head with light markings 15
15. A red band or blotch on top of head, remainder of head mottled white and black; white rings on body and tail 31 .... *thayeri*
    Head black and white, not mottled (except snout) 16
16. White rings two and one half scale lengths middorsally; ventrals 228 to 233 .... *triangulum schmidti*
    White rings narrower, about one and one-half scale lengths 17
17. Ventrals 200 to 224; snout light .... *triangulum nelsoni*
    Ventrals 227 to 235; snout dark, with a transverse white bar .... *triangulum oligozona*

TABLE 1.

Variation in LAMPROPELTIS MEXICANA (*Garman*).

Number	Sex	Scale Rows	Vent.	Caud.	Supl.	Infl.	Proc.	Ptoc.	Spots	Total Length (mm.)	Tail Length (mm.)
19022	♂	21–23–19	199	60	7–7	10–10	1–1	2–2	36–9	257	43
19023	♂	21–23–19	191	58	7–7	9–9	1–1	2–2	39–11	245	41
19025	♂	21–23–19	193	56	7–7	10–10	1–1	2–2	35–11	250	41
24977	♂	19–23–19	192	59	7–7	9–9	1–1	2–2	31–9	594	100
24979	♂	21–23–19	195	56	7–7	9–9	1–1	2–3	41–9	288	46
24981	♂	23–23–19	194	57	7–7	9–9	1–1	2–3	37–10	777	128
19024	♀	21–23–19	196	53	7–7	10–10	1–1	2–2	47–11	745	118
24976	♀	21–23–19	193	..	7–7	9–10	1–1	2–2	32–?	643+	93+
24978	♀	23–23–19	199	56	7–7	9–10	1–1	2–2	36–9	638	105
24980	♀	23–26–21	199	..	7–7	10–10	1–1	2–2	34–9	622+	95+
4652	♀	23–21–19	193	55	7–7	10–10	1–2	2–2	39	803	...
4653	♀	23–21–19	199	55	7–7	10–10	1–1	2–2	39	452	...
Gto.	♀	21–23–19	191	51	7–7	10–10	1–1	2–2	33–8	380	60

WILLIAM BARTRAM'S NAMES OF BIRDS[1, 2]

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The names to be discussed here were all published in Bartram's *Travels* (original edition of 1791). The vicissitudes that they have experienced constitute an interesting and rather strange chapter in the annals of American ornithology.

We need not here concern ourselves particularly with the use of some of Bartram's names by Wilson and others in the early part of the past century. That was largely before the day of the serious discussion of nomenclatural principles and the adoption of codes of nomenclature (beginning with the Stricklandian Code of 1842).

We may take up a historical review of these names at the point where they began to be discussed by Dr. Elliott Coues, their principal and almost sole champion hitherto. In the original edition of his *Check List of North American Birds* (1873; reissued in his *Field Ornithology* of 1874), he utilized certain of Bartram's specific names; *e. g., Cathartes atratus* (Bartr.), *Aphelocoma floridana* (Bartr.), and *Quiscalus purpureus* (Bartr.).

In 1875 Coues published a brilliant and (in a large measure) justifiable defense of such of Bartram's names as are binominal. He reprinted the descriptive catalogue of 215 birds from pages 289 to 296 of the *Travels,* and identified the species, in so far as he was able, in the light of contemporary ornithological knowledge. Coues maintained (1875, p. 342) that Bartram "is systematically binomial on principle, with occasional lapses, which, however, do not invalidate his system any more than the similar deviations from strict binomiality in the . . . cases of Schlegel or Bonaparte." And further, that "Such of his species as are binomially named and fully identified must take their rightful place in the curriculum of synonymatic quotation; and those names which are found to possess the quality of priority must be adopted."

Under the present International Rules (Art. 25), a technical name, to be valid, must be "accompanied by an indication, or a definition, or a description." The mere addition of a vernacular name does not fulfill this requirement (Opinion 1). Otherwise the arguments advanced by Coues remain perfectly sound to-day. In his championship of Bartram, however, the prophet was little honored by either his contemporaries or his successors.

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[2] Received for publication April 6, 1942.

J. A. Allen, the inveterate opponent of Coues, took up the cudgels at once (1876a). While making much of Bartram's partial polynomialism, he did not deny the validity of certain of the binominal names in the *Travels.* He did, however, whittle down the list of 21 names "which Dr. Coues wishes to see set up" to a mere six or seven—"the only ones that, in justice to all parties, can rightfully stand." Coues had admitted a number of technical names that were identifiable solely by means of the accompanying common names and perhaps by the ranges assigned to the species; but Allen was right in rejecting such names.

In his reply (1876), Coues pointed out that there were only ten Bartramian species that he had proceeded to "newly set up"; and that "the only actual disagreement between Mr. Allen and myself is that he is able to identify satisfactorily rather fewer of Bartram's species than I succeeded in doing."

In temporarily closing this debate, Allen (1876b) stated: "The point at issue is not whether 'Bartram's identifiable, described, and binomially named species' are entitled to recognition, for no one would be foolish enough to deny that."

After this clarification of issues, Coues utilized, in the second edition of his *Check List* (1882), the following Bartramian names (here set down in the order of their appearance on pages 289–296 of the *Travels*):

Catharista atrata (Bartr.)
Elanus glaucus (Bartr.)
Ictinia subcoerulea (Bartr.)
Corvus maritimus Bartr.
Corvus frugivorus Bartr.
Aphelocoma floridana (Bartr.)
Quiscalus purpureus (Bartr.)
Dendroeca pinus (Bartr.)
Meleagris gallipavo americana Bartr.
Spizella domestica (Bartr.)
Melospiza palustris (Bartr.)
Spizella agrestis (Bartr.)
Troglodytes domesticus (Bartr.)
Telmatodytes palustris (Bartr.)
Grus pratensis (Bartr.)
Botaurus mugitans (Bartr.)
Aramus pictus (Bartr.)
Phalacrocorax dilophus floridanus (Bartr.)

Herewith the Bartramian nomenclatural tide may be said to have reached its peak. The four successive editions of the *American Ornithologists' Union Check-List* (1886 to 1931) by degrees obliterated almost the last vestige of his names. The first two editions (1886 and 1895) retained, of the above-mentioned 18 names, only *Catharista atrata* and *Aphelocoma floridana.* This action may seem remarkable, in view of the fact that Coues was chairman of both committees that prepared the first and second editions; but as he himself said (1899, p. 84), he had "always been in a minority of one on this subject."

The third edition of the *Check-List* (1910) recognized not a single Bartramian name! The preface naively admitted (p. 8) "the tendency heretofore to ignore rules of nomenclature when their observance entailed unwelcome changes in technical names." In the meantime, in a paper entitled *The Finishing Stroke to Bartram* (1899), Coues had given up the unequal fight, and had himself proposed that the Committee, to be consistent, eradicate the two Bartramian names retained in the first two *Check-Lists.* At the same time he maintained his personal conviction that Bartram "is a binomial author who sometimes lapses, and whose identifiable binomials which rest upon descriptions are available in our nomenclature." This view is perfectly sound in the light of the present International Rules of Zoological Nomenclature (as issued in Paris in 1905, with subsequent amendments), but Coues was considerably ahead of his times! The A. O. U. Committee in 1899, under the chairmanship of Robert Ridgway, accepted Coues' suggestion and ruled as follows (Auk, vol. 16, p. 112, 1899): "As Bartram was not a strict binomialist his names are not tenable, although in two instances they have been heretofore inadvertently used in the Check-List."

As a matter of fact, it does not seem possible to find any specific justification for this attitude even in the old A. O. U. Code of Nomenclature (1886 and 1908), and most decidedly not in the current International Rules.

In the fourth edition of the *A. O. U. Check-List* (1931), the Committee, under the chairmanship of Witmer Stone, stated (p. vii): "The International Code of Nomenclature which corresponds closely with the A. O. U. Code has been adopted as a basis for the nomenclature of the Check-List but where the latter Code is more explicit and carries its rulings to further detail it has been followed." But by this time the Bartramian names were apparently an almost forgotten issue. It is true that three of the names (*Coragyps atratus atratus, Grus canadensis pratensis,* and *Aramus pictus pictus*) were revived, but curiously credited to F. A. A. Meyer (1794), who had merely published a free translation of some of Bartram's descriptions of animals, with added comments of his own. There is apparently nothing in print to indicate that Bartram's names have ever been seriously reconsidered in the light of the International Rules.

Peters, in his *Check-list of Birds of the World* (vol. 1, p. 190, 1931; vol. 2, pp. 152, 155, 1934), has credited one of the above-mentioned names to Bechstein (1793) and two to Meyer (1794).

As I have said elsewhere (1940, p. 695), "any particular binominal name proposed by Bartram may be judged upon its individual merits, regardless of the fact that many of his other names are polynomial." It merely remains, therefore, to select those of Bartram's names that are binominal, are accompanied by nomenclaturally valid descriptions, are identifiable beyond reasonable question, and have priority. The restoration of these names to their rightful place in current nomenclature can hardly be denied. A few other names that come into consideration, but seem to require rejection, are also discussed.

It may be remarked here that a German translation of Bartram's *Travels,* edited by E. A. W. Zimmermann, was published in Berlin in 1793. The editor added certain notes of his own that gave a new status to some of the names proposed by Bartram (*cf.* Mathews, 1914). These cases, however, are not included in the present discussion.

Bartram's plant names, in so far as they are identifiable and have priority, are fully accepted by botanists. This is particularly significant in view of the fact that the International Rules of Botanical Nomenclature (1935), unlike those of Zoological Nomenclature, require the rejection of specific names "when they were published in works in which the Linnean system of binary nomenclature for species was not consistently employed" (Art. 68).

The following bird names are taken up in the order of their appearance in the catalogue on pages 289 to 296 of the *Travels.* Some of them, however, were introduced at various places in the text preceding or following this catalogue. Designation or restriction of the type localities have been facilitated by recently acquired information on the details of Bartram's itinerary (*cf.* Harper, 1939).

To each name in Bartram's catalogue is prefixed one of five different symbols, indicating the bird's status as a migrant or a resident in various parts of the country. In certain cases where such a symbol is important in identifying the species, the use of the symbol will be mentioned.

Page 289. "Strix acclamator, capite levi, corpore grisco [misprint for "griseo"], the whooting owl." (Introduced as "strix acclamatus" (a *nomen nudum*) on p. 286.) This species, especially when compared with the five other species of *Strix* introduced on the same page, is clearly identifiable as the Northern Barred Owl, currently known as *Strix varia varia* (*Strix varius* Barton, 1799). The prefixed symbol (¶) indicates that this is one of the species that "breed and continue the year round in Pennsylvania." Bartram's name, with eight years' priority, will supplant Barton's (which, incidentally, was derived from "Bartram. MS."). The type locality may be restricted to West Philadelphia, Philadelphia County, Pennsylvania (where Bartram's home was located). The names of the various subspecies will stand as follows:

Strix acclamator acclamator Bartram. Northern Barred Owl.

Strix acclamator georgica (*Strix georgica* Latham, 1801). Florida Barred Owl.

Strix acclamator sablei (*Syrnium nebulosum sablei* Nicholson, 1938). Cape Sable Barred Owl.

Strix acclamator helveola (*Syrnium nebulosum helveolum* Bangs, 1899). Texas Barred Owl.

Strix acclamator sartorii (*Syrnium nebulosum* var. *sartorii* Ridgway, 1873). Mexican Barred Owl.

Strix acclamator fulvescens (*Syrnium fulvescens* Sclater and Salvin, 1868). Guatemalan Barred Owl.

Page 289. "Vultur atratus, black vulture, or carrion crow." (An adequate description, under the name of "coped vulture" or "carrion crow," is given on p. 152.) This must be recognized as the original reference of the Black Vulture (*Coragyps atratus atratus*), and it may be cited as follows: *Vultur atratus* Bartram, Travels, ed. 1, pp. 289, 152, 1791. Since the description on page 152 occurs at a point in Bartram's narrative where he is describing his voyage on the St. John's River just above Lake Dexter, Florida, the type locality may be fixed accordingly. Bartram's drawings ("Tab. VII" and "Tab. VIII") of "The Caron Crow of Florida," which are preserved in the British Museum, may be considered to represent the type specimen.

Page 290. Here three species of "Falco" are introduced under the heading of "Milvus. Kite Hawk." There is also a brief characterization of "Kite hawks" in a footnote. The symbol "||" indicates that all three species "are natives of Carolina and Florida, where they breed and continue the year round." All three are readily identifiable, as follows:

"Falco furcatus, the forked tail hawk, or kite," is the Swallow-tailed Kite (*Elanoides forficatus forficatus* (Linnaeus, 1758)).

"F[alco] glaucus, the sharp winged hawk, of a pale sky-blue colour, the tip of the wings black," is the White-tailed Kite, currently known as *Elanus leucurus majusculus* Bangs and Penard (1920). On this point both Coues (1875, p. 345) and Allen (1876a, p. 28) agree. The name of the northern subspecies will now become *Elanus glaucus glaucus* (Bartram), supplanting *majusculus* of Bangs and Penard. Apparently the first actual specimen on record from Florida was obtained by Titian R. Peale on the estate of Prince Achille Murat at Moses Creek, about 8 miles south of St. Augustine (Bonaparte, 1828, vol. 2, p. 24). The type locality may be restricted to that area. Bartram had frequently been in the vicinity of St. Augustine in 1765 and 1766. The name of the South American subspecies will become *Elanus glaucus leucurus* (*Milvus leucurus* Vieillot, 1818).

"F[alco] subcerulius, the sharp winged hawk, of a dark or dusky blue colour," is the Mississippi Kite, currently known as *Ictinia misisippiensis* (*Falco misisippiensis* Wilson, 1811). Again Coues (1875, p. 345) and Allen (1876a, p. 28) agree. The name will now become *Ictinia subcerulia* (Bartram). The type locality may be restricted to Oldtown on the Suwannee River, Dixie County, Florida. This locality was visited by Bartram (p. 235), and the species was formerly abundant there (Wayne, 1893, p. 337; 1906, p. 62).

Page 290. "Corvus carnivorus, the raven," is probably identifiable as the Northern Raven (*Corvus corax principalis* Ridgway, 1887). Without an accompanying description, however, the name must be considered a *nomen nudum*.

Page 290. "C[orvus] maritimus, the great sea-side crow, or rook," is apparently either the Northern Raven (just introduced as the preceding species) or some otherwise undescribed and presumably extinct species or subspecies of Florida. It is evidently the same bird that Bartram refers to in his manuscript report to Dr. Fothergill (vol. 2, p. 49, 1774?; original in Brit. Mus.) as a "very large" Crow that "keeps near the Sea coast [of East Florida], has a loud course voice like the Raven." Barton, a close friend and collaborator with Bartram, has some further remarks upon it (1799, p. 11, footnote). I cannot agree with Coues (1875, p. 346) in identifying it as the Fish Crow (*Corvus ossifragus* Wilson), which Bartram apparently did not distinguish from the various subspecies of *Corvus brachyrhynchos.* Wilson (1812, vol. 5, p. 29), in describing *C. ossifragus,* differentiates it from Bartram's *C. maritimus.*

Page 290. "C[orvus] frugivorus, the common crow." I am inclined to consider this composite, including both the Eastern Crow (*Corvus brachyrhynchos brachyrhynchos* Brehm) and the Fish Crow (*C. ossifragus* Wilson). The latter species, according to Ord (in Guthrie, 1815, p. 325), was "always confounded with the foregoing [Common Crow], until Mr. Wilson introduced it as a distinct species." In Coues' opinion (1875, p. 346), *C. frugivorus* Bartram was the equivalent of *C. americanus* Audubon. In any event, however, it is a *nomen nudum.*

Page 290. "C[orvus] Floridanus, pica glandaria minor, the little jay of Florida," is further described on page 172, and is unmistakably identifiable as the Florida Jay, currently known as *Aphelocoma coerulescens* (*Corvus coerulescens* Bosc, 1795). Bartram's name was recognized in the first two editions of the *A. O. U. Check-List,* and must now be revived, as *Aphelocoma floridana* (Bartram). The original reference may be cited as *C[orvus] Floridanus* Bartram, Travels, ed. 1, pp. 290, 172, 1791. The particular bit of Florida "scrub" to which Bartram refers (pp. 171–172) as the habitat of this species is located 13 miles southwest of Palatka, between Rodman and Deep Creek, Putnam County, Florida; and this may be designated as the type locality.

Page 290. "Gracula quiscula, the purple jackdaw of the sea coast," may be identified as the Atlantic Boat-tailed Grackle (*Cassidix mexicanus torreyi* Harper, 1935)—at least this subspecies for the most part. The symbol "¶" is employed by mistake for "‖." The name is evidently a *nomen nudum;* even if valid, it would be preoccupied by the *Gracula quiscula* of Linnaeus (1758), who proposed it for the Florida Grackle.

Page 289 *bis.* "Gracula purpurea, the lesser purple jackdaw, or crow blackbird." The prefixed symbol (*) indicates birds that "arrive in Pennsylvania in the spring season from the South, which, after building nests, and rearing their young, return again Southerly in the autumn." The words "lesser purple" imply a comparison with the preceding species, "the purple jackdaw of the sea coast," and serve to identify the bird as some form of the genus *Quiscalus* breeding in Pennsylvania. Bartram's name, if valid, would have priority over any one of the three names now applied to Pennsylvania forms of *Quiscalus* (*cf.* Chapman, 1936, p. 411, map). If, however, the English words supplied by Bartram may be interpreted as constituting merely vernacular names, rather than a description, his name may be discarded as a *nomen nudum* (*cf.* Opinion 1, Intern. Comm. Zool. Nomencl.). Thus existing nomenclature need not be disturbed.

Page 289 *bis*. "Certhia rufa, little brown variegated creeper." Here again we must decide whether the English words quoted constitute a description or merely a vernacular name. The latter interpretation will enable us to preserve the current name of the Eastern Brown Creeper (*Certhia familiaris americana* Bonaparte, 1838). In 1805 Bartram gave a detailed description and a figure of this bird, but supplied no specific name with the generic name *Certhia*.

Page 289 *bis*. "Lanius griscus [misprint for "griseus"], the little grey butcher-bird of Pennsylvania." This case may be decided in the same manner as those just preceding. There is also some slight uncertainty as to which shrike Bartram was attempting to name, although it was probably the Migrant Shrike (*Lanius ludovicianus migrans* W. Palmer, 1898).

Page 289 *bis*. "M[uscitapa] [misprint for "Muscicapa"] cristata, the great crested yellow bellied flycatcher." The prefixed symbol (*) indicates a breeding bird of Pennsylvania. Thus Bartram clearly had in mind the Northern Crested Flycatcher, currently known as *Myiarchus crinitus boreus* Bangs (1898). The case, however, is similar to the several immediately preceding. Moreover, Bartram's name is preoccupied by *Muscicapa cristata* J. F. Gmelin (1789).

Page 289 *bis*. "M[uscitapa] [misprint for "Muscicapa"] subviridis, the little olive cold. flycatcher." Both Wilson (1810, vol. 2, p. 77) and Coues (1875, p. 348) consider this the Acadian Flycatcher, currently known as *Empidonax virescens* (Vieillot, 1818). However, no less than four species of *Empidonax* breed in Pennsylvania, and there is virtually nothing in Bartram's words to differentiate between them. His name is best considered unidentifiable. In any event, it is probably a *nomen nudum.*

Page 290 *bis*. "Merula flammula, sand-hill redbird of Carolina," and "M. Marilandica, the summer red bird." The identification of these two names, even though they are *nomina nuda,* has been an intriguing puzzle. They obviously apply to the two common tanagers of the Eastern States. Since Bartram was thoroughly familiar with the works of Catesby (1731–1743) and of Edwards (1758–1764) and frequently referred to them, one would expect him to preserve their name of "Summer Red-Bird" for *Piranga rubra rubra* (Linnaeus). In fact, his remark (p. 302) on "classing the summer red-bird with the muscicapa" is very strong evidence on this point. For of the two species in question, only the Summer Tanager (*P. r. rubra*) is treated as a *Muscicapa* by Catesby (1731–1743, vol. 1, p. 56), Edwards (1758, pt. 1, p. 63), and Linnaeus (1766, p. 326). Moreover, in his manuscript report to Dr. Fothergill (vol. 2, p. 50, 1774?; original in Brit. Mus.), Bartram writes: "The Summer Red bird is here [in East Florida] in summer season. a species with black wings & Tail only pass along in the spring to the N°. Colonies where they breed." This shows clearly that his "Summer Red bird" is the same as Catesby's. Again, in Bartram's own copy of the *Systema Naturae* of 1758 (acquired by him in 1808), there is an annotation, apparently in his own script, "Summer Red Bird," beside the name *Fringilla rubra* (which applies to Catesby's bird). With all this evidence at hand, it seems quite safe to conclude that the "Merula flammula" of the *Travels* is the Scarlet Tanager (*Piranga erythromelas* Vieillot, 1819), while the "M. Marilandica" is the Summer Tanager. Coues (1875, p. 349) made his identifications accordingly (the name *rubra* in his day being erroneously applied to the Scarlet Tanager).

At the same time it may be well to admit that there is some slight evidence on the other side of the question. The Scarlet Tanager, as the species of more northerly distribution, might be the one more likely to receive the specific name of "Marilandica," since the other is referred to as a bird of Carolina. As a matter of fact, the specimen of the Scarlet Tanager figured by Edwards (1764, pt. 3, p. 278, pl. 343) was sent "from Maryland." Furthermore, in Bartram's diary of 1802–1822, which contains numerous notes on birds of the vicinity of Philadelphia, there is only one entry referring to the "Sandhill Redbird" in contrast to five records of the "Summer Redbird." Since the Scarlet Tanager presumably has always been the commoner of the two species about Philadelphia, Stone (1913, p. 348) identifies the "Summer Redbird" in this case as *erythromelas*, and the "Sandhill Redbird" as *rubra*. Finally, Wilson (1808, vol. 1, p. 95) lists Bartram's *Merula flammula* as a synonym of the Summer Redbird. However, this may signify nothing more than that the meanings of the two names had somehow become transposed since the publication of the *Travels*. Linnaeus in 1766 had caused confusion by applying the name *rubra* (in different genera) to both of these tanagers.

Page 290 *bis*. "Lucar lividus, apice nigra, the cat bird, or chicken bird." There is a further account on pages 299–300, including a reference to the *Muscicapa vertice nigro* of Catesby, which forms the basis for the *Muscicapa carolinensis* of Linnaeus (1766). Thus Bartram's validly described species is unmistakably the Catbird, currently known as *Dumetella carolinensis* (Linnaeus). His specific name is antedated by that of Linnaeus, but his generic name has priority over several others proposed for the Catbird, and it must take its place in current nomenclature. The objections to it, as stated in the Eighth Supplement to the A. O. U. Check-List (Auk, vol. 14, p. 134, 1897), simply do not hold water under the International Rules. The genus may be cited as follows: *Lucar* Bartram, Travels, ed. 1, pp. 290 *bis*, 299, 1791; type, by monotypy, *Lucar lividus* Bartram = *Muscicapa carolinensis* Linnaeus (1766). The specific name will stand as *Lucar carolinensis* (Linnaeus).

Page 290 *bis*. "Meleagris Americanus, the wild turkey." The prefixed symbol (¶) indicates birds that "breed and continue the year round in Pennsylvania." The name as here presented can be validated only by some further description. The first whole paragraph on page 14 describes a "large turkey of the native wild breed" seen in McIntosh County, Ga. (The *Meleagris silvestris* of Vieillot (1817) is based primarily upon the description in this paragraph; hence the restriction of the type locality of *silvestris* to "Pennsylvania" (A. O. U. Check-List of 1931, p. 92) is obviously incorrect.) The next paragraph gives a general description of "our turkey of America," and the maximum weight of "near forty" pounds ascribed to it would apply much more probably to northern birds (such as those in Pennsylvania) than to the birds of southeastern Georgia. It thus appears quite justifiable to connect the name on page 290 *bis* with the description in the second paragraph on page 14. Bartram's name becomes validated accordingly, and the Eastern Wild Turkey will be known as *Meleagris gallopavo americana* Bartram (Travels, ed. 1, pp. 290 *bis*, 14 (par. 2), 1791) rather than as *M. g. silvestris* Vieillot. The type locality of Bartram's bird may be restricted to Chester County, Pennsylvania, where it was formerly resident (Burns, 1919, p. 48).

Page 83. "The wild turkey-cock (Meleagris occidentalis)." This name is applied to Wild Turkeys on the St. John's River, Fla., perhaps at the mouth of Clark's Creek, Clay County. Unfortunately Bartram here employs but a single descriptive phrase, "silver bordered train" (p. 84). Moreover, while this description fits the Domestic Turkey, it does not apply to the Florida Wild Turkey (*Meleagris gallopavo osceola* Scott, 1890). Consequently Bartram's name, although having 99 years' priority over Scott's, can scarcely be considered available.

Page 291. "Linaria ciris, the painted finch, or nonpareil," and "L. cyanea, the blue linnet." These names, standing alone without references, would be *nomina nuda*, although identifiable. They are further discussed, however, on page 299, as "Linaria ciris (emberiza ciris Linn.)" and "Linaria cianea (tanagra Linn.)." They thus become new combinations of *Emberiza ciris* Linnaeus (1758) and *Tanagra cyanea* Linnaeus (1766). The generic name is new here in post-Linnaean usage, although it was employed by Catesby (1731–43) in his *Linaria caerulea*, which formed the basis for the *Tanagra cyanea* of Linnaeus. *Linaria* Bartram thus becomes the valid name of the genus to which the Indigo Bunting and the Painted Bunting belong, and it will replace *Passerina* Vieillot (1816), the type of which, by subsequent designation, is *Tanagra cyanea* Linnaeus. The genus may be cited as follows: *Linaria* Bartram, Travels, ed. 1, p. 299, 1791; type, by present designation, *Emberiza ciris* Linnaeus (1758). This change of generic names will involve the following species and subspecies:

Linaria cyanea (*Tanagra cyanea* Linnaeus, 1766). Indigo Bunting.

Linaria amoena (*Emberiza amoena* Say, in Long, 1823). Lazuli Bunting.

Linaria versicolor versicolor (*Spiza versicolor* Bonaparte, 1837). Varied Bunting.

Linaria versicolor pulchra (*Passerina versicolor pulchra* Ridgway, 1887). Beautiful Bunting.

Linaria versicolor dickeyae (*Passerina versicolor dickeyae* van Rossem, 1934). Mrs. Dickey's Bunting.

Linaria versicolor purpurascens (*Passerina versicolor purpurascens* Griscom, 1930). Guatemalan Bunting.

Linaria rositae (*Cyanospiza rositae* Lawrence, 1874). Rosita's Bunting.

Linaria ciris ciris (*Emberiza ciris* Linnaeus, 1758). Eastern Painted Bunting.

Linaria ciris pallidior (*Passerina ciris pallidior* Mearns, 1911). Western Painted Bunting.

Linaria leclancheri leclancheri (*Passerina leclancheri* Lafresnaye, 1840). Leclancher's Bunting.

Linaria leclancheri grandior (*Passerina leclancheri grandior* Griscom, 1934). Oaxaca Bunting.

Page 291. Coues (1875, pp. 350–351) attempts to revive six Bartramian specific names that were published on this page, as follows:

"C[arduelis] pinus, the lesser goldfinch."

"Passer domesticus, the little house sparrow or chipping bird."

"P[asser] palustris, the reed sparrow."

"P[asser] agrestis, the little field sparrow."

"M[otacilla] domestica (regulus rufus) the house wren."

"M[otacilla] palustris, (reg. minor) the marsh wren."

All these names are more or less identifiable by reason of the vernacular names supplied, but they are not thereby validated in a nomenclatural sense, and so they must be discarded as *nomina nuda.*

Page 291. "Calandra pratensis, the May bird." The generic name, although new here, is not available, for the genotype is a *nomen nudum,* despite the fact that it is identifiable as the Dickcissel (*Spiza americana* (Gmelin, 1789)).

Pages 291–292. The case of "Regulus" is so fraught with unfortunate possibilities in the way of transfer and confusion of names that I prefer to pass it by for the present. Much trouble would be saved if *Regulus* Cuvier (1800) could be added to the list of *nomina conservanda.*

Page 292. "Ruticilla Americana, the redstart." *Ruticilla,* although new as a generic name in post-Linnaean usage, is not available, since the genotype is a *nomen nudum.*

Page 292. "Luscinia, s. philomela Americana, the yellow hooded titmouse." If *Philomela* can be construed as a generic name, this is its first occurrence as such in the literature. At best, however, it is no more than a *nomen nudum.*

Page 292. "P[arus] cedrus, uropygio flavo, the yellow rump." Edwards (1758, pt. 1, pp. 97–98, pl. 255) describes, and gives a colored plate of, the "Yellow-rumped Fly-catcher." He had received this bird "from Mr. William Bartram, of Pennsylvania." It is clearly the Magnolia Warbler, currently known as *Dendroica magnolia* (Wilson, 1811). Bartram's present "yellow rump" should naturally be the same species. The only other species to which "Parus cedrus" might apply is the Myrtle Warbler (*Dendroica coronata* (Linnaeus, 1766)), but the latter is accounted for a few lines below as "P[arus] aurio vertice, the golden crown flycatcher." It is evident, however, that Bartram confused these two species over a long period of years. The "Yellow rump Flycatchers" of his manuscript report to Dr. Fothergill (vol. 2, p. 50, 1774?; original in the Brit. Mus.) and the bird represented under this name in one of his drawings (No. 11) at the British Museum are no doubt the Myrtle Warbler. In a letter of March, 1791, to B. S. Barton (original in possession of Mrs. John R. Delafield), he was still quite confused concerning the two species. Finally, on page 298 of the *Travels,* his "yellow rump (parus cedrus)" is obviously the Myrtle Warbler. Apparently Bartram applied this last name to the birds in winter plumage, and the "P. aurio vertice" to adult males in spring plumage. But in that case he did not realize that the "Yellow-rumped Fly-catcher" he had sent to Edwards many years previously was an entirely distinct species, the Magnolia Warbler. Under all these circumstances it is probably best to identify *Parus cedrus* as the Myrtle Warbler in winter plumage; and to consider that Wilson (1810, vol. 2, p. 138) and Bonaparte (1824, p. 193) were correct in placing both of the Bartramian names here discussed in the synonymy of *Dendroica coronata.*

Page 292. The publication, on the same page, of "P[arus] aureus vertice rubro, the yellow red pole," and "P. aureus alis ceruleis. the blue winged yellow bird," together with the omission of the comma after "aureus" in each case, creates such a strong suspicion of polynomialism that perhaps we need not consider these names further at present.

Page 293. "G[rus] pratensis, corpore cinereo, vertice papilloso, the great savanna crane." This bird is further described on pages 146–147 and 220–221, where it is referred to as "grus pratensis" and as "Grus p." These accounts constitute the valid original description of the Florida Sandhill Crane (*Grus canadensis pratensis*). The name *pratensis,* proposed by Bartram, is improperly credited to Meyer (1794) by Peters (1925, p. 12) and by the *A. O. U. Check-List* of 1931 (p. 94). Peters misplaces the type locality in Clay County, Florida. The specimen described by Bartram was not obtained in "the eastern part of the Alachua Savanna"; and this savanna, incidentally, is comprised wholly within Alachua County. The specimen was shot by Bartram's hunter companions within a few miles of the present Bronson, Levy County, Florida, and the type locality must be designated accordingly. The nearest approach to a type specimen (the original having been eaten) is a drawing ("Tab. II") made by Bartram and now preserved in the British Museum.

Page 293. "A[rdea] mugitans, the marsh bitern, or Indian hen." This bird, while identifiable as the American Bittern (*Botaurus lentiginosus* (Montagu, 1813)), is not validly described. Therefore the name *mugitans* cannot be adopted, as Coues suggests (1875, p. 353).

Page 293. "T[antalus] pictus, (Ephouskyka Indian) the crying bird, beautifully speckled." This bird, the Florida Limpkin, is more fully described, under the same name, on pages 147–148. Both the description and the nomenclature are valid, and Bartram, instead of Meyer (1794), must be credited with the authorship. The original reference should be cited as follows: *Tantalus pictus* Bartram, Travels, ed. 1, p. 147, 1791. In future lists the name will stand as *Aramus scolopaceus pictus* (Bartram). In his manuscript report to Dr. Fothergill (vol. 1, p. 95, 1774?; original in Brit. Mus.), Bartram tells of shooting a specimen on the St. John's River in the vicinity of St. Francis, Lake County, Florida. This may be appropriately designated as the restricted type locality. The type specimen was apparently eaten, but it may be represented by a drawing made by Bartram and published by Barton (1818, pl. 1).

Page 294. "A[nser] branta, corpore albo, remigibus nigris, the white brant goose." This name unquestionably applies to either the Lesser Snow Goose (*Chen hyperborea hyperborea* (Pallas, 1769)) or the Greater Snow Goose (*C. h. atlantica* Kennard, 1927). Or, in view of the distribution indicated by the symbol "†," it may apply to both (the latter bird being more usual in Pennsylvania, while the former is the only one of the two that is definitely known to occur in Florida). The description does not differentiate between the two subspecies. There is also at least a slight suspicion of polynomialism, since the next entry (an unmistakable polynomial: "A. branta grisca maculata") duplicates the second term in the name now under consideration. Under all these circumstances it is probably best to consider that *branta* of Bartram is not available, although it has priority over *atlantica* of Kennard.

Page 295. "C[olymbus] Floridanus, the great black cormorant of Florida, having a red beak." The prefixed symbol (||) indicates birds that "are natives of Carolina and Florida, where they breed and continue the year round." This is unmistakably the Florida Cormorant, currently known as *Phalacrocorax auritus floridanus* (*Carbo floridanus* Audubon, 1835). The description may be considered more valid than accurate, for "red beak" might have been better expressed as "orange lores and gular pouch." It seems justifiable to substitute the *floridanus* of Bartram for the later *floridanus* of Audubon. Thus the Florida Cormorant may be known hereafter as *Phalacrocorax auritus floridanus* (Bartram). The type locality may be restricted to Mosquito Lagoon on the east coast of Florida. This locality was visited by Bartram (p. xxv), and it forms one of the breeding areas of the Florida Cormorant (Howell, 1932, p. 92).

Page 295. "Petrella pintada, the pintado bird." This name suggests the Pintado Petrel, currently known as *Daption capense* (Linnaeus, 1758). However, *Petrella pintada* is merely *a nomen nudum* here, since there is no accompanying description. The generic name as well as the specific is new in post-Linnaean usage, but it cannot be validated with a *nomen nudum* as genotype. It is difficult to comprehend the basis of Bartram's name, unless possibly it is the "white and black Spotted Peteril" of Edwards (1747, pt. 2, p. 90, pl. 90, lower fig., and p. 128 (as "Petrella, media, maculata")), who mentions the Portuguese name of "Pantado." However, there is no known record of the Pintado Petrel (a bird of the southern oceans) in North America up to and including Bartram's time.

For a critical reading of the manuscript, either as a whole or in part, I am much indebted to Messrs. James Bond, Ezra T. Cresson, Jr., Henry W. Fowler, H. Radclyffe Roberts, Alexander Wetmore, and John T. Zimmer. While there has been no resulting unanimity of opinion, a decisive majority agrees that the proposals here made are in accordance with the International Rules.

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NEWS AND NOTES

THE PROCEEDINGS

During May of this year, the paper of Dr. Robert B. Simpson entitled: *Studies in the geography of population change, Canandaigua Lake region, New York,* appeared in these *Proceedings* as No. 2 and 3 of Vol. 8. The Council has voted that members of the Academy may receive its current publications free of charge upon request. Such requests should be sent to the Librarian of the Academy, Rhees Library, University of Rochester.

The Council has voted that an effort will be made to assign one-half of all current and future dues towards the financing of *The Proceedings.* Further, the Council has voted not over $500 of capital funds towards publication of *The Proceedings* for the current year. If we are to continue publication additional current income is essential. Increased membership is greatly desired. Those who can make a contribution towards the cost of *The Proceedings* in addition to the $2.00 annual dues are urgently requested to do so.

Missing Numbers: Certain numbers of the *The Proceedings* are either entirely missing from the Academy files offered for sale, or very few copies remain. These numbers are greatly desired so that the Academy may offer complete sets for sale. Will authors or members who have any of these copies, and are willing to part with them, send them to the Librarian of the Academy. The numbers especially desired are:

SARGENT, C. S. Crataegus in Rochester. Vol. 4:93–136, 1903.

BECKWITH, FLORENCE, M. E. MACAULEY, and M. S. BAXTER. Plants of Monroe County, New York, and adjacent territory: supplementary list. Vol. 5:1–38, 1910.

BECKWITH, FLORENCE. Early botanists of Rochester and vicinity, and the Botanical Section. Vol. 5:39–58, 1910.

Biographical memoirs of deceased fellows, title pages, etc. Vol. 5:241–288.

FAIRCHILD, H. L. The Rochester Canyon and the Genesee River base-levels. Vol. 6:1–55, 1919.

GILES, A. W. Minerals in the Niagara limestone of Western New York. Vol. 6:57–72, 1920.

FAIRMAN, E. E. The fungi of our common nuts and pits. Vol. 6:73–115, 1921.

On motion of Dean Gamble the Council elected David R. Goddard as Chairman of the Publications Committee; Dr. Gamble remaining a member of the Committee. Since Dr. Goddard will be out of town from September, 1942, until August, 1943, Dr. S. C. Bishop was elected to serve as Chairman during Dr. Goddard's absence.

D. R. G.

GENERAL MEETINGS

April 28, 1941.—This meeting was held to celebrate the sixtieth anniversary of the founding of the Botanical Section. The Academy welcomed as its speaker Dr. Josiah Lowe of the State College of Forestry at Syracuse. The topic of his lecture was *Lichens.*

Dr. Lowe had collected lichens extensively on Isle Royale in Lake Superior and also in this state. He gave an interesting account of their structure, growth and economic importance.

An unusual feature of this meeting was the presence of Miss Isles, who, fifty-nine years before, had presented before the Academy a paper on the very subject of the evening's discourse, *Lichens!* Her membership in the Academy's Botanical Section began less than a year after its inauguration.

October 27, 1941.—A symposium on *Alaska* was presented by President Floyd C. Fairbanks and Professor F. W. C. Meyer, both of whom had visited there during the summer just past. President Fairbanks showed kodachrome movies which included excellent views taken in the Canadian Rockies. Professor Meyer followed the Lewis and Clarke trail from Chicago to Seattle and made a study of the Indian tribes with whom he came in contact. He was particularly interested in their totems and in the effect of so-called "civilization" on their social and religious life.

November 25, 1941.—A joint meeting with the Rochester Astronomy Club and the Rochester Section of the Optical Society of America was held on the River Campus of the University. The speaker was the distinguished astronomer, Dr. Chandrasekhar, of the Yerkes Observatory—a native of India. His subject was *The Dynamics of Stellar Systems.*

Although using a language foreign to him, Dr. Chandrasekhar succeeded admirably in presenting an abstruse subject in as simple a manner as possible. Our galaxy and the great nebula of Andromeda were the examples to which he chiefly referred. From evidence furnished by the galaxy itself he stated that its age is of the order of three billion years. Its form is that of a flattened disc with more than one-half its mass concentrated in a dense nucleus consisting of between one and ten billion stars. Our sun is at a point about two-thirds of the distance from the center to the edge of the disc, some ten thousand parsecs from the center, around which it is circling at the rate of approximately 250 kilometers per second.

January 26, 1942.—The annual business meeting. The speaker was Dr. Justus F. Mueller of the State College of Forestry at Syracuse, who gave an illustrated lecture on his recent journey across Peru from Lima to Yurimaguas. Much of this dangerous trip was made on rafts or in crude canoes with semi-civilized native boatmen. Dr. Mueller's kodachrome slides were excellent.

February 16, 1942.—This was a joint meeting with the Morgan Chapter of the New York State Archaeological Association and was held in the new building of the Rochester Museum at East Avenue and Goodman Street. It was the first public lecture to be held in this building, which was not yet completed.

The speaker was Dr. Arthur C. Parker, Director of the Rochester Museum of Arts and Sciences. His topic was *Revivals of Material Culture among the Iroquois.* From the time the Indians began to use things they could not make, their life became dependent on the white races and their own arts began to degenerate. In a few generations it became impossible to find even samples of some of the things which were once commonly made. Their ancient religions, and all that was based upon it, was despised.

It was in an effort to revive some of the lost arts of the Iroquois that lead Dr. Parker in 1935 to undertake to interest certain inhabitants of the Tonawanda and Cattaraugus reservations in the old crafts of carving, painting, beadwork, weaving, leatherwork, etc. Much artistic work was done and some worth-while talent was discovered, but the general conclusion reached was that evolution, even under artificial conditions, is not easily reversed. The Indians consistently looked upon their productions as toys and curiosities rather than as patterns for their own lives. Movies were shown and records of Indian music were played.

March 23, 1942.—Dr. David R. Goddard of the Department of Botany, University of Rochester, gave an illustrated lecture on *Light Chemistry and Life,* in which he discussed some of the applications of photochemistry to photosynthesis, in such a way as to clarify them in the minds of those whose previous concepts may have been rather vague.

April 13, 1942.—The Research Section sponsored a general meeting addressed by Dr. Bernard Nebel of the New York State Agricultural Experiment Station, Geneva, on the subject, *Recent Trends in Agricultural Research.* He described the growth of governmental aid to agriculture and mentioned some of the more serious problems of the modern farmer. "To be successful on a farm," he said, "one must have experience, a technical education, and a knack for good business." He briefly outlined the modern research in three fields: the weather, the soil, and the plants, themselves. The Norwegians have made a science of weather forecasting, the Russians have evolved a practical soil classification, and Americans have put both into practice. Dr. Nebel discussed the technical methods of plant breeding by which species are improved and varieties developed, such as the use of x-rays to re-align chromosomes, and the use of colchicine.

May 11, 1942.—Dr. Dudley S. De Groot addressed the Academy on the subject of *Bird Migration.* His talk was not confined by this title but ranged as well over various of his experiences in egg collecting, from Maine to Florida to California. The first nest of the San Benito sparrow ever to be collected is his chief prize. Many times he has visited eagle nests without once being attacked by the birds. In waters filled with alligators he has stalked the sand-hill crane of Florida, and on the isle of Mani he has welcomed the plover migrating from the Aleutians. In due time he hopes to arrange his collection of over ten thousand eggs so that it may be inspected and studied. M. N. S.

MINERALOGY SECTION

The Mineralogy Section of the Rochester Academy of Science meets once each month from October to May inclusive, on the second Thursday of the month. During the 1941–1942 season, the first five indoor meetings were held at Ward's Natural Science Establishment, 302 N. Goodman Street. The sixth and seventh meetings were held in the Eastman Building on the Prince Street Campus of the University of Rochester, and the eighth meeting, preceded by a picnic supper, was held at the Girl Scout's "Little House" at Seneca Park. In addition to the indoor meetings, four field trips were held in 1941. All plans for subsequent trips have been canceled for the duration of the war.

The Indoor Meetings for the year 1941–1942 were as follows:

October 9.—W. McClelland—*An Hour with Gems.*

November 13.—General meeting for members.

December 11.—F. W. C. Meyer—*Glaciers and Water Erosion.*

January 8.—John M. Dowe, Jr.—*Prospecting.*

February 12.—Nelson Secrist—*Minerals in the Arts.*

March 12.—G. E. Houghton—*Asbestos.*

April 9.—Robert C. Vance—*Meteorites.*

May 14.—John E. Hartfelder—*Collecting Experiences.*

Field Trips:

May 24, 1941.—Collecting minerals at limestone quarry southeast of Sodus.

June 14, 1941.—Collecting septaria in Bristol hills.

July 4, 5, 6, 1941.—A three-day trip to mineral localities in eastern Vermont and New Hampshire. At Gassetts, Vt., a quarry in mica schist yielded crude crystals of garnet, kyanite and staurolite. The Golden Keene feldspar mine near East Alstead, New Hampshire, produced large beryl crystals, garnet and tourmaline crystals, quartz, feldspar and mica. A soapstone quarry at Chester, Vt., was the source of choice crystals of pyrite and magnetite, together with ankerite, prochlorite, talc, actinolite and steatite.

September 21, 1941.—A joint field trip with the Geological Section of the Buffalo Society of Natural Sciences to Eighteen-Mile Creek near Buffalo. Led by Mr. Carter, many good Devonian fossils and pyrite nodules were collected.

Officers of the Mineral Section

ROBERT C. VANCE	Chairman
DAVID E. JENSEN	Recorder
GEORGE R. COSTICH	Treasurer
EDWIN G. FOSTER	Chairman of the Committee for Recording Mineral Localities of Monroe County.
DAVID E. JENSEN	Chairman of the Committee for New York State Mineral Localities
JOHN M. DOWE, JR.	Chairman of the Field Trip and Program Committees
CHARLES W. FOSTER	Chairman of the Summer Activities Committee

R. C. V.

RESEARCH SECTION

May 15, 1941.—Dr. Robert B. Simpson of the Department of Geology of the University was the speaker. His title was: *Why is the Canandaigua area becoming depopulated?* His talk was based on the material used in writing his paper since published in the Proc. Rochester Acad. Sci. 8:49–121 (1942).

The first three of the following meetings were designed to discuss various aspects of the general subject of macro-molecules.

November 17, 1941.—The speakers were Mr. Arthur Schoen and Dr. Maurice L. Huggins of the Research Laboratories, Eastman Kodak Company. Dr. Schoen discussed the *Design and use of the electron microscope* and reported on some of the results obtained in the examination of photographic emulsions. Dr. Huggins spoke on the *Chemistry of macro-molecules.*

December 8, 1941.—The speaker was Dr. Robert Ramsey, of the Department of Physiology, University of Rochester School of Medicine and his title was *Myosin and the molecular theory of muscle contraction.*

January 19, 1942.—Dr. Curt Stern and Dr. John B. Buck, of the Department of Zoology, University of Rochester, participated in a symposium entitled *Chromosomes, genes, and proteins.*

February 16, 1942.—Dr. Arthur C. Parker, Director, Rochester Museum of Arts and Sciences, spoke on the subject, *Revivals of material culture among the Iroquois.* (See notes on General Meetings.)

March 9, 1942.—Dr. Henrik Dam, Research Associate, Department of Biochemistry, University of Rochester School of Medicine, and the discoverer of Vitamin K, told of some of his work in a talk under the following title: *Biological significance of vitamin K.*

April 13, 1942.—Dr. Bernard R. Nebel, of the New York State Agricultural Experiment Station, Geneva, N. Y., was the speaker and his title was, *Recent trends in agriculture research.* (See notes on General Meetings.)

At the Meeting of April 13, 1942, the Executive Committee nominated the following officers, who were elected, for the current year:

CHAIRMAN - - - - - - Dr. Richard H. Goodwin
RECORDER - - - - - - - Dr. William S. Cornwell
MEMBERS OF THE EXECUTIVE COMMITTEE
Professor Sherman C. Bishop
Dr. Dean L. Gamble
Dr. Robert L. Roudabush

The Research Section abolished its special dues; membership is now open to all Members of the Academy for the usual Academy dues. W. S. C.

THE HERBARIUM OF THE ROCHESTER ACADEMY OF SCIENCE

Through the activity of the members of the Botanical Section of the Academy the excellent herbarium of the Rochester Academy of Science has been built up during the past sixty years. A history of the Botanical Section and the lives of many of its members have been written up in these Proceedings (Proc. Roch. Acad. Sci. 5:39–58, 1912; 8:122–149, 1942). Among the principal early collectors whose mounted specimens are now housed in the herbarium were Mr. George T. Fish, Mr. Joseph B. Fuller, Mr. Edward L. Hankenson, Mr. Charles W. Seelye, and Miss Florence Beckwith. Many others who have made smaller contributions could be listed. In 1939 title to two collections previously on deposit in the herbarium came to the Academy, those of Mr. Milton S. Baxter and of Mr. Ellsworth P. Killip. These collections are notable both for their size and their scientific value, Mr. Baxter's consisting chiefly of plants native to western New York and Mr. Killip's containing a large percentage of plants collected in the West Indies and Central and South America.

In 1930 the Rochester Academy of Science placed its herbarium on deposit with the University of Rochester. The specimens were housed in steel cabinets on the ground floor of the Dewey Building on the River Campus, under the supervision of the Botany Department. Mr. Milton S. Baxter served as curator of the combined herbaria of the Academy and of the University until the time of his death in 1938. Since then I have served in this capacity. In 1941 a new, well-lighted room on the ground floor of Dewey Building was made available for the herbarium and it is to be hoped that in these convenient and attractive quarters the collections will grow and continue to serve a useful purpose for many years to come.

The mounted specimens in the combined collections of the University and of the Academy have been estimated at between 40,000 and 45,000 sheets. Of these, by far the greater part belong to the Academy. Specimens in the Academy herbarium have been marked with the following stamp: *Herbarium of the Rochester Academy of*

Science on deposit with the University of Rochester. The herbaria of the Academy and of the University are now combined into a single unit. A small reference collection of representative specimens of species to be found in New York State has been kept separate as a means of reducing the handling particularly of old and fragile specimens. All other specimens have been placed in the main herbarium. The families have been arranged according to the system of Engler and Prantl—a system adopted by many of the larger herbaria. The genera and species are in alphabetical sequence under the families.

A large quantity of additional unmounted material belonging to the Academy is also stored at the University. These specimens are not arranged and will not be readily available for study until they can be labelled and mounted.

Since 1938 the following accessions numbering 1228 mounted sheets can be reported in addition to the collections of Mr. Baxter and Mr. Killip previously mentioned. Many of these are University accessions, but they have been included here since the usefulness of the collection should be measured by the amount and nature of the material available for study. Mr. Ellsworth P. Killip, 191 specimens; the U. S. National Museum, 180 specimens; Dr. Edgar Anderson of the Missouri Botanical Gardens, 25 specimens; Dr. Royal E. Shanks, 25 specimens; Mr. Warren Mathew, 5 specimens; Dr. R. H. Goodwin, 702 specimens; students in the Botany Department of the University, about 100 specimens.

Richard H. Goodwin, *Curator.*

MEMBERS OF THE ACADEMY

* Indicates Life Members.
† Indicates Fellows.

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James K. Albright	*476 Grand Avenue*
Dr. Harold L. Alling*†	*31 Barrington Street*
Mrs. Harold L. Alling	*31 Barrington Street*
Leon C. Allyn	*67 Park Avenue*
Mrs. Kai Anderson	*42 Shepard Street*
Miss Kate R. Andrews	*19 Prince Street*
Melvin D. Andrews†	*402 Ravenwood Avenue*
Professor Guy A. Bailey†	*Geneseo, New York*
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Edward Bausch*†	*663 East Avenue*
Florus R. Baxter*†	*55 Glen Ellyn Way*
Everett G. Beine	*44 Morningside Park*
Dr. George P. Berry	*Univ. of Rochester Medical School*
Miss Ruth Bishop	*63 Custer Street*
Professor Sherman C. Bishop	*Univ. of Rochester, Dept. of Zoology*
Miss Melissa E. Bingeman	*90 Prince Street*
Dr. W. R. Bloor	*Univ. of Rochester, Medical School*
W. H. Boardman†	*1060 South Avenue*
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