TRANSACTIONS

OF THE

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HELD AT PHILADELPHIA,

FOR PROMOTING USEFUL KNOWLEDGE.

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BIOGRAPHICAL MEMOIR

OF

THE LATE FRANÇOIS ANDRÉ MICHAUX.

BY ELIAS DURAND.

Read Dec. 5th, 1856.

François André Michaux, the subject of this memoir, belonged essentially to that class of scientific explorers who, by their devotion to science and their energy in promoting the welfare of mankind, may, justly, be viewed in the light of benefactors of their race.

When we consider the noble spirit with which such men enter upon their hazardous enterprises; when we witness the fortitude with which they encounter the fatigues and inconveniences of their distant voyages in regions as yet unexplored, we cannot withhold from them the expression of our admiration. It is not a spirit of egotism that moves them onwards; it is not for their personal gratification, nor with the view of enriching themselves by their discoveries, that they desert their family-hearth and separate themselves from the father-land. Their object is disinterested and of the noblest character. They labour for the advancement of science, and, above all, for the benefit and enjoyments of their fellow-beings.

To what toils, to what privations and dangers, must they not necessarily expose themselves in order to attain the object they have in view? Behold them wending their way through inextricable forests; through pestilential marshes; over grounds untrodden by the human foot—struggling and panting under the rays of a torrid sun, or shivering under heavy showers of rain—now clambering over steep rocks, and next descending into deep precipices, constantly exposed to dangers of every description.

To men of this class we already owe many of those succulent vegetables which cover our tables; those delicious fruits which enrich our gardens and orchards; those fine trees, shrubs and flowering plants which grow by the side of our native trees, ornament our parterres and pleasure grounds, or are cultivated in our green-houses. The Peach, the Apricot, the Cherry, the Almond, as well as the greater part of our most valuable garden vegetables, were obtained from Asia, the cradle of the human race; the Walnut came from the Black Sea; the Pear, the Apple, the Chestnut, from the forests of Europe; the Orange from India; the sugar-cane from China; the Maize and Potato from South America, &c. And, ere long, through the perseverant exertions of François Michaux, Europeans will en-

joy, in their own fields, the refreshing shades of the finest and most useful trees of our native forests, of those, especially, which are employed in civil and naval constructions, or in cabinet work. As Americans, we are ourselves under peculiar obligations to him for an accurate knowledge of our forest trees and for the good advices which his experience has enabled him to give us on points of national economy connected with arboriculture.

François André Michaux was born on the 16th of August, 1770, at Satory, a royal domain situated in the vicinity of Versailles, which, for several generations, had been intrusted by the Crown to the administration and management of his ancestors. He was the only son of André Michaux, who, with Catesby, Clayton, Bartram, Kalm and Walter, was one of the pioneers of botanical explorations in the North American regions. His mother, Cecile Claye, was a daughter of a rich farmer of Beauce. She died, eleven months after her marriage, leaving behind her a son, the subject of this notice.

Of the early life of François André Michaux, I have not been able to collect much information. It is probable that he was brought up on the farm of Satory, in the practical school of his father and of one of his uncles, upon whom devolved, after the departure of the former, the sole management of this extensive royal estate. It may be inferred also from his writings and instructive conversation, that his collegiate education had not been neglected.

His father, whose history is inseparably linked with that of his son, had devoted all his life to the progress of agriculture and the sciences; his main ambition had been to effect something that might redound to the advantage of his native country, and, with this view, he had early turned his attention to agriculture, the advancement of which, he had soon perceived, could not be more securely attained, than by enriching its domain with such products of foreign climes as were unknown to his own country, and susceptible of acclimation. In order to accomplish his object, he determined to visit new regions, possessing climates similar to that of France, and to bring back thence such of their productions as might prove of advantage to his native land.

To effect that purpose, he prepared himself by a proper course of studies, and by devoting his particular attention to the science of Botany, under the great Bernard de Jussieu. He first visited England; he next made several explorations in the mountains of Auvergne, and in the Pyrennees; then in Spain, and embarked afterwards for Persia, in the capacity of Secretary to the French Consul at Ispahan; but, in reality, for the sole purpose of exploring that country, then almost unknown to scientific men. From 1782 to 1785, he surveyed the whole of the Persian provinces, between the river Tigris and the Euphrates, and returned to France, with an extensive collection of specimens, and a large quantity of seeds of every kind.

During the absence of the elder Michaux, the French government had been agitating the important question of introducing into the forests of France, such exotic trees as would be calculated to increase the national resources, with respect to naval constructions. The information which had been received from the United States in this regard, had been exceedingly encouraging, and Michaux, who had just returned from Asia, was chosen for that particular errand, with instructions to procure, for the royal nurseries, all the young trees, shrubs and seeds he could possibly send. In consequence, he made all proper dispositions, and embarked at Lorient, on the 25th of August, 1785, taking with him his son, then only fifteen years of age, and a journeyman gardener of the name of Paul Saulnier, of whom I shall speak hereafter. They landed at New York on the first of October following.

At this remote period of time, I am altogether without record as to the movements of young Michaux, immediately after his landing on our shores. The only source where I expected, naturally, to obtain information, was the manuscript journal in which his father was in the habit of registering the daily incidents of his eventful life, and which had been deposited by his son in the library of the American Philosophical Society. Unfortunately, this journal has become incomplete, through the absence of

three of its fasciculi, containing the years 1785, 1786 and 1790, which were lost in the shipwreck of the elder Michaux on the coast of Holland. In the fasciculus of 1787, young Michaux's name appears for the first time on the date of May 6th, as accompanying his father in his exploration to the sources of the Keovee river. In the next spring, he is seen again with him, journeying into the interior of Florida. He is, afterwards, mentioned several times, as being retained at the Charleston Nursery, either on account of ill health, or intrusted with the management of the plantation, during the journeys of his indefatigable and ever-moving father.

In the further perusal of the manuscript, I learn, at the date of the 20th of September, 1789, that, on that day, his son walking along the road, was hit by a man shooting at partridges, and that a grain of shot had penetrated his left eye, below the pupil. From that date to December following, he occasionally speaks of the state of his son, of the treatment applied to his case, and, especially, of the great despondency of mind in which the patient had fallen, from the apprehension of losing his eye. But, here again we arrive at the third lost fasciculus, and I cannot ascertain the final result of the accident, nor at what time, precisely, young Michaux returned to France.

His return must have taken place in the first three months of 1790, for, in the manuscript of the following year, on the 17th of January, the elder Michaux acknowledges the receipt of a letter from his son, dated Paris, April, 1790, but nothing more is said about the wounded eye. To that accident, which is not generally known, may be attributed the partial deprivation of sight with which Michaux was afflicted.

Young Michaux, therefore, reached his country at the very outbreak of the French revolution, in which he is said to have warmly sympathized with the republican party. Such a course was not, perhaps, expected from one who had been brought up on a royal domain, and was, to a certain degree, indebted to royal munificence. But, on the other hand, how could the feelings of this generous and impressible young man be otherwise enlisted? His exalted patriotism, his ambition to serve his country, his frank and bold temper; his love of liberty, which he had imbibed in this free and happy land —all these together must have raised his spirits to a high pitch, in conjunction with the vexation he experienced when, on his return, he scarcely found a few remnants of the several hundred thousand young trees, which his father and himself had reared, in their American nurseries, and sent home for the particular benefit of his country. One half of these had been given away by the Queen to her imperial father of Austria; the rest had been squandered among the minions of the court, to embellish their grounds, or shamefully neglected in the royal nurseries of Rambouillet.

In the mean time, the elder Michaux was continuing his explorations in North America. He travelled in all directions, over more than three thousand miles, during the eleven years which he spent on this side of the Atlantic. While thus actively engaged, the political storm, raging in his country, had brought on immense changes in his situation. France, ruined by royal profligacy; invaded by famine; deluged with the blood of her best citizens; convulsed by civil war and fighting, single-handed, with the whole of Europe, could no longer afford to pay her naturalists abroad. Consequently, Michaux was forgotten, and ceased gradually to receive his salary. After having borrowed money on his own account; after having sacrificed a portion of his own, and of his son's fortunes, he found himself under the necessity of returning to his country. Unfortunately, he was shipwrecked on the coast of Holland, and, after having lost the best part of his immense collections, he arrived in Paris on the 26th of December, 1796, after an absence of eleven years and four months.

On his arrival in his native land, the elder Michaux occupied his time in the cultivation of the vegetable treasures which he had forwarded from the United States, and in arranging his materials for the *history of the North American Oaks*, and for his *Flora Boreali Americana*. In these various labours, he was assisted by his son, who, in the meantime, was studying medicine under the celebrated

Corvisart, and attending the clinical lectures of Désault, chief surgeon of the Hotel Dieu, with the view of returning to the United States, and devoting himself to the practice of medicine; but such was not his destiny!

Neither the retired habits of a student, nor the easy and monotonous life of a Parisian abode suited temperaments like those of the two Michaux. Such men needed activity and change of scenes, even with toils and perils. Both were animated with the same spirit of enterprise, with the same conviction that their efforts, employed in other directions, could afford more benefit to their country; hence, they were endeavouring, through the influence of their numerous friends, to infuse their views and projects into the minds of their fellow members of the Central Society of Agriculture, and of the ministers of Napoleon, then First Consul of the French Republic.

In this they both succeeded finally. The elder Michaux accepted a commission of naturalist in the scientific expedition led by Captain Baudin, and bound to the Australian seas, on condition, however, that he would be permitted to remain at the Isle of France, if he desired so to do. Disgusted with Baudin's haughty manners and want of courtesy to the scientific corps, André Michaux abandoned the expedition at Mauritius, where he remained six months, and thence started for the island of Madagascar, which, he thought, would afford him better opportunities of advancing the science of Botany, and making himself more useful to his country.

After sundry explorations along the coast, he established a botanical garden at Tametave, in which he planted all the trees and plants which might be objects of usefulness or curiosity. The climate, unfortunately, was exceedingly unhealthy, and trusting too much to his good constitution, and habits of exposure, he neglected the proper precautions, was taken sick with fever, and died at the end of December, 1803.

François André Michaux, on his own account, had not remained inactive. Aroused by the example of his father, and now fully arrived at manhood, he could not look back to the unfinished work of his father in the United States, without becoming alive to the most ardent desire to achieve the object which they had both in view. Conversant with several States of the Union, confident in his own experience and abilities further to serve his country, he was, on his side, earnestly soliciting a commission to the United States.

This opportunity was at last afforded to him through the celebrated De Chaptal, then Minister of the Interior, who feeling dissatisfied with the result of the nurseries of New Jersey and Charleston, since the departure of the elder Michaux, and thinking more benefit would accrue from the appointment of native correspondents in the principal seaports of the Union, consulted François A. Michaux in the matter, and appointed him to effect those objects. He gave him instructions, at the same time, to sell the properties, when he should have forwarded home all the trees and shrubs remaining in the two French nurseries above mentioned.

Michaux, highly gratified, set out immediately for Bourdeaux, at which port he embarked for Charleston, with the same Captain, and on the same vessel that had brought him home thence, some ten years previous. After a short and pleasant passage, he landed at his place of destination, on the ninth of October, 1801. He occupied himself almost immediately, and during the following winter, in sending to France the trees and shrubs of the nursery, and this part of his instructions being fulfilled, he embarked for New York on the same errand.

As soon as the season became favourable, he began his herborizations in New Jersey, and along the banks of North River. In these explorations, he discovered several new species of Oaks and Hickories, the acorns and nuts of which he sent to France in abundance. He had also the opportunity of determining with more accuracy, the botanical characters of the Black Oak (*quercus tinctoria*,) one of the largest trees of the American forests, and, also, one of the most valuable for the good quality of its wood, as well as for its dyeing properties.

He next visited Philadelphia, where he had the pleasure of becoming acquainted with some of her most celebrated men, among whom he mentions the Rev. Dr. Collin, Dr. Benj. S. Barton, Messrs. Vaughan, Peale, Wm. Bartram, &c. He visited with great satisfaction, the botanical garden of the latter gentleman, and the magnificent green houses of Mr. Wm. Hamilton, which contained a rich collection of exotics, principally New Holland plants. His attention was more particularly attracted by the latter gentleman's romantic grounds, called Woodland, wholly planted with every American tree and shrub that could withstand the severity of a Philadelphia winter. Then, finding he had a few months to dispose of, he took advantage of this circumstance to visit the states of Kentucky and Tennessee, about which he had so frequently heard his father speak in the most enthusiastic terms.

Accordingly, he set out from Philadelphia, on the 27th of June, 1802; passed through Lancaster, Columbia, York, Carlisle and Shippensburgh; then crossing the Allegheny mountains, he reached Pittsburgh in ten days, travelling alternately in stage, on horse-back or on foot. He left Pittsburgh on the 14th of July, on foot, for Wheeling, and there purchased a canoe to descend the Ohio river, in company with an American officer of the name of Craff. In three days, they reached Marietta, and, on the tenth day, they landed at Limestone, now Maysville. From that place, he travelled alone to Lexington, which he left on the 10th of August for Nashville.

Michaux remained in Nashville four weeks, which were employed, principally, in herborizations around the town and along the banks of the Cumberland river. On the fifth of September, he set out on his journey back to Charleston, by way of Fort Blunt, West Point and Knoxville, which latter place he reached on the 17th, after stopping several days at the Falls of Roaring River, to explore the beautiful country around. From Knoxville he travelled to Greenville, and thence to Jonesborough, the last town of Tennessee. On the 21st he began crossing the high ridge which divides the State of Tennessee from North Carolina, and after two days of the most toilsome journey through the mountains, he reached the farm of old Davenport, who had been formerly his father's guide in that rugged region.—There he remained a week, for the double purpose of resting and conversing with him about his dear father, who, shortly after, on the inhospitable coast of Madagascar, died a victim to the climate and to his zeal for the progress of science. On the second of October, Michaux reached Morgantown, two hundred and eighty miles from Charleston, and arrived in the latter city, on the 18th, by way of Lincoltown, Chester, Winnsborough and Columbus, after having travelled over eighteen hundred miles in three months and a half.

Such was François André Michaux's exploring journey to the Western states, of which he published a very detailed account, two years afterwards, in a work entitled "*Voyage à l'Ouest des Monts Allegheny, &c. &c.*" During this journey, he did not merely devote his attention to botanical pursuits; but, with his usual habits of observation and extraordinary sagacity of mind, he diligently inquired into the state and modes of agriculture; the nature of the different soils; their particular vegetable productions, and the commercial relations existing between those remote regions and the Atlantic cities. He always felt, afterwards, a considerable pleasure in relating the episodes of this long and toilsome journey through these regions, then but thinly settled, and yet the abode of the roving Indian tribes.

He spoke with enthusiasm and in terms of unreserved gratitude, of attentions of which he was the object; his name was a passport which insured to him a most hearty welcome, and every assistance from those who had known his father, and had received from him seeds for planting, or instructions in farming. To the new settlers, he was always provided with letters of introduction, which procured him the same good reception. Every where he was hailed with manifestations of respect for the memory of his father, and with unanimous expressions of a desire to be useful to the son in any way within their power.

Michaux remained in Charleston until the first of March, 1803, when he embarked again for France,

in the same vessel on board of which he had sailed from the port of Bordeaux, eighteen months before, and landed at that port on the 26th of the same month. On his arrival in Paris, he made every effort in hastening the publication of his father's "*Histoire des chênes d'Amérique*," which had been printed in 1801, but the plates of which had not yet been completed. He attended also to the publication of the "*Flora Boreali Americana*," under the supervision of Claude Richard, an eminent botanist and a superior writer. Both these works were finally announced to the scientific world in the years 1803 and 1804, and were eagerly expected by those who took an interest in the vegetable productions of North America.

In the latter year, Michaux published his "*Journey to the West of the Allegheny Mountains*," and the following year his memoir "*Sur la Naturalisation des Arbres Forestiers de l'Amérique du Nord.*" In this memoir, addressed to the Central Society of Agriculture of Paris, of which he was a prominent member, he endeavoured to prove the great advantage which might accrue to France from the acclimation of better trees than those which her native forests actually possess, and of such, principally, as might well succeed in soils too poor for any of the French trees to thrive therein. In support of his opinion, he pointed out the swampy lands of France, as producing no wood of any value, whilst similar lands in America are covered over with noble and valuable trees, such as the Red Elm, Willow Oak, white Cedar, white and black Cypress, &c. He, likewise, pointed at the sandy, and certain cretaceous soils of France, as giving growth to nothing but dwarfish and insignificant pines, while the equally arid lands of the southern states produce an abundance of the live Oak, a tree exceedingly valuable in naval architecture, and which might also well succeed in the sandy maritime soils of the southern departments of France.

Besides these advantages, Michaux proposed to increase the number of forest trees which, in France, is limited to thirty-six, attaining the height of thirty feet; eighteen of which form the bulk of the forests, and seven only are employed in civil and naval constructions—whilst he alone had observed in the North American forests as many as one hundred and forty species of similar height and utility.

The means proposed by Michaux to attain these desiderata, were simply "to send a naturalist to the United States, with the mission to collect seeds and young trees, and to forward the same to the national nurseries of France." His propositions were forcibly supported in a report made to the Central Society of Agriculture by Messrs. De Perthuis, Correa de Serra and Cels, and he was, finally, intrusted with this mission, under the special patronage of the Duke De Gaëte, then minister of Finance and for the account of the Administration of the Forests.

He, subsequently, embarked at Bourdeaux, on the 5th of February, 1806, in a vessel bound to Charleston. After being three days at sea, they were boarded by the British man of war Leander, Commander Witheby, who, suspecting the vessel to be laden for the account of French merchants, sent her to Halifax, there to be disposed of by the court of Admiralty, which would decide whether she was a legitimate prize, or should be liberated. Of all the passengers, Michaux was the only one ordered on board the Leander, where he remained during a cruise of forty-three days, after which they reached the Bermuda Islands. While in port, he was permitted freely to go ashore, and had thus the opportunity to make some interesting observations, the details of which he addressed to the Professors of the Paris Museum of Natural History, in a memoir entitled "*Notice sur les Iles Bermudes, et, particulièrement, sur St. Georges.*"

Michaux was finally released, and permitted to sail for the United States, which he reached towards the end of May. Beginning his explorations at the district of Maine, where the winter is as rigorous as in Sweden, though ten degrees farther south, he travelled over all the Atlantic States as far as Georgia, where the heat, during six months of the year, is as great as in the West Indies. Besides a journey of 1800 miles from north-east to south-west, he made five explorations into the interior of the

country.—The first, along the rivers Kennebeck and Sandy; the second, from Boston to lake Champlain, crossing the States of New Hampshire and Vermont; the third, from New York to lakes Ontario and Erie; the fourth, from Philadelphia to the rivers Monongahela, Allegheny and Ohio; the fifth, from Charleston to the sources of the Savannah and Oconee rivers. In travelling along the sea-coast, he visited the principal dock-yards, with the view to examine the timber employed in ship-building; he also entered in all the work-shops where wood was worked into forms. As the knowledge of which he was in need, was, principally, in the possession of artisans, he, accordingly, consulted the most skilful workmen, and by means of a series of questions, previously prepared, he collected a mass of valuable information.

In his different journeys into the interior, he paid a particular attention to the trees that formed the bulk of the forests, with reference to the nature and uses of their woods, or as objects of commerce between the different states, or of exportation abroad. He ascertained the sources of the different barks employed in tanning; inquired into the quality and price of the various woods used for fuel, and formed a complete collection of polished specimens of the species employed in cabinet work or otherwise. In a word, the range of his observations was unlimited, and could not fail to interest exceedingly the people of the United States, as well as Europeans, and to become one of the main points of the splendid work which he published, almost immediately, after his return.

Michaux remained nearly three years in the United States, diligently employed in his arduous task. During his residence, he formed many valuable acquaintances. Besides the late Muhlenberg, Hamilton, Barton, Hosack, Alex. Wilson, Eddy, &c., he was on terms of friendship with others still living, among whom I may mention Dr. John Francis of New York and Major Leconte. Michaux was elected a Member of the American Philosophical Society on the 21st of April, 1809; and we have a proof of the value in which he held this honour, by the handsome provision made in favour of this institution, in his testament, bearing date of May 30th, 1852.

I should fail in my duty towards one, who was the companion and helpmate of the two Michaux, if I omitted here to mention his name. This is the humble Paul Saulnier, the same journeyman gardener who, in 1785, had accompanied them to this country, and was intrusted with the care of the New Jersey nursery. François Michaux never spoke of him but with feelings of respect and affection.

"Originally of France," says Dr. Francis in his eloquent discourse on the Natural Sciences, "his early life was absorbed in practical horticulture, as an experimenter in vegetable physiology, and as one of the subordinates of the Jardin des Plantes. Here, he had instilled into him the principles of *ordines naturales*, by their author, de Jussieu. Shortly after, he was selected for his botanical attainments, to accompany the elder Michaux to this country. He proved serviceable as a collector. By royal means, Louis XVI., by whose patronage Michaux was authorized to procure American productions, a plot of ground in New Jersey was appropriated as a suitable garden for rearing and preserving plants and trees, mainly designed for the institutions of France.

In this sequestered place, Paul, with the exception of occasional excursions to New York and to parts adjacent, passed the remainder of his days. Here he was visited by the younger Michaux, Pursh, Douglas, Bradbury and other foreign naturalists who reached our shores. Poor Wilson, the Ornithologist, often found shelter within his humble dwelling from the lowering sky and tempestuous storms, and often I have heard Michaux enlarge on the refreshing enjoyment of Paul's hospitality. Paul was a sort of Sir Oracle with them; and his responses were heeded by all who sought practical knowledge in natural history. Paul, I believe, may be estimated the first, as to time, who without much pretension, inculcated among us the classification of Jussieu, and the arboriculturist may perhaps be now, for the first time, informed that to him are we to assign the introduction into this country of the Lombardy poplar. Paul holds a place in the progress of botanical pursuits not unlike that enjoyed so long by

the venerable Wm. Bartram, though I should be reluctant to assign to him a place as conspicuous as that of our philosophical traveller.

Let Michaux speak of the goodness of his heart and of his disinterested philanthropy: "Paul was so exclusive in his attentions to his avocations, that hardly any other subject than trees and plants ever found entrance into his mind. To the day of his death, he considered his little circumscribed residence as still the property of his royal master; and ignorant of the vicissitudes of political revolution, reluctantly gave credence to the fact of the decapitation of his bountiful, but unfortunate King. Paul now lies in the Hackensac churchyard; his tomb-stone records not half his excellence."

On Michaux's return to Paris, he presented himself before the Central Society of Agriculture, to which he was mainly indebted for his mission to the United States, and there gave an account of his voyage, of the various tasks he had performed and of the flattering results which had been already obtained:—From the seeds which he had forwarded during his absence, more than two hundred and fifty thousand young trees had already sprung up, which were fairly promising to accomplish, in succeeding times, the objects contemplated by him, and confidently expected by his fellow members of the Society of Agriculture, who appointed a committee to report on the success of his voyage. Correa de Serra, chairman of that committee, in a most flattering report, highly complimented Michaux on the faithful execution of his trust, and for the importance of the services he had rendered to his country, he called forth a vote of thanks.

During the two years following his return, Michaux was actively employed in the publication of his great work: "*Histoire des Arbres Forestiers de l'Amérique du Nord,*" so anxiously expected by all who took an interest in the Flora of the United States, and in the observations of one so well versed in agricultural pursuits. The first volume appeared in 1810; the second, in 1812, and the third, in 1813.

This magnificent work, illustrated by 144 copper plates, designed by the two Redouté and by Bessa, and engraved by such eminent artists as Gabriel, Renard, Boquet, Bessin, and Dubreuil, was translated into English by Augustus L. Hillhouse, and published in Paris in four volumes by Charles D'Hautel (1817—1819) under the title of "*North American Sylva,*" with the addition of several plates and some new observations by the author. Mr. Wm. Maclure purchased the plates in Paris, and brought them to this country. To this circumstance is owing the publication of two American editions, which are likely, soon, to be followed by a third. The first, was issued at New Harmony, Indiana, in 1842, and the second, in this city, in 1852, with notes by J. J. Smith, Esq. Mr. Nuttall, soon after, published, on Michaux's plan, an additional *Sylva Americana,* describing and illustrating as many as one hundred and twenty trees, mostly unknown to his predecessor, indigenous to the far west regions, Oregon and California included.

Of this splendid work of Michaux, the author of an article on the botany of the United States, published in the 13th Vol. of the North American Review, remarks: "It is the plan of Michaux's history of our forest trees, to unite the advantages of a work strictly botanical and one relating to the useful arts; but, especially, to collect all the scattered details which books or experience could furnish him, with respect to the application of various kinds of wood to the purposes of life. Botanical descriptions can easily be made or found; but, in order to ascertain their useful properties, it was necessary to consult artisans, in almost every branch of practical mechanics, to frequent dock-yards, or workshops in which wood was employed, and in short, to gather information from every attainable source. From these inquiries Michaux had obtained a most extensive collection of curious and important facts, which rather belonging to the application of botany than to botany itself, are nevertheless essential to the complete knowledge of the plants of the United States; for, besides the commercial and practical uses of our trees, we have a very perfect account of the inflorescence, fructification, growth and botanical habit of them individually considered, as also many interesting facts with regard to them taken together as composing forests."

In a letter, dated October, 1852, addressed through Mr. Isaac Lea, to the President of the American Philosophical Society, Michaux expresses himself in the following words, with regard to his *Sylva Americana:* "The science of botany was the principal object of my father's explorations in North America, and the *Flora Boreali-Americana*, was the result of those explorations. As for me, I took another view of the vegetable kingdom, whilst in your country—a view more limited and less scientific, it is true; but, perhaps, more generally profitable to the farmer and landholder, as well as to that class of society, so numerous in the Northern States of the Union, who employ wood in so many different ways. I do not consider my *Sylva Americana* as complete as it might be; thus, for instance, I have omitted several species which grow in lower Louisiana, and in the two Floridas. In the second place I have described and figured some trees that are deficient in the flowers and in the fruits. Had circumstances permitted, I would have returned to the United States, and, in a new edition, have corrected the errors, and filled up the omissions. I would thus have been able to present to the American nation, a work worthy of her great name, but now that I have arrived at a very advanced age, nearly 83 years, I can do nothing more, in this respect, than to express my regrets, and the hope that some native arboriculturist may complete my researches on the plan which I have adopted. The publication of such a work would be attended with much benefit to the country, and afford particular honour to him who would undertake it."

Since the appearance of his great work, Michaux has devoted all his attention to his favourite pursuits—the cultivation and propagation of trees, presenting a special object of public utility. Intrusted with the administration of a large estate belonging to the Central Society of Agriculture; experimenting largely in sylviculture on the extensive plantations of Mr. Delamarre, and owning himself a country place near Pontoise, he never ceased until his death, to be actively employed in experiments on arboriculture, either suggested by himself or others.

Michaux had retained in this country a few correspondents, who sent him occasionally new supplies of seeds, and, through a letter furnished by one of these gentlemen, I had the gratification to become acquainted with him, in the autumn of 1824.

When living in Baltimore, from 1816 to 1824, I formed an intimacy with a French gentleman of the name of Leroy, who had known Michaux in this country, and had been since in correspondence with him. This Mr. Leroy, who was himself an excellent arboriculturist, having been earnestly solicited by his friend to send him all the seeds and young trees which he could procure in the vicinity of Baltimore, applied to me, as a fellow botanist, to assist him in this undertaking. We, therefore, went to work together in earnest, during the autumn of 1819, rambling into the woods with a negro boy, climbing and beating Oaks, Maples, and Hickory trees; uprooting the shrubs and young trees that fell in our way, and collecting seeds of every sort. The result of our campaign filled up several large boxes which were forwarded to Michaux, in the early part of the winter.

When I visited Europe in 1824, Mr. Leroy favoured me with a letter of introduction to his friend, recommending me as his co-labourer in the collections which had been forwarded to him from Baltimore, some years previous. This letter did not fail insuring to me a hearty welcome at the hands of Mr. Michaux. I saw him frequently, and breakfasted with him at his winter quarters in Paris, on the place St. Michael, which was then a market for garden vegetables and fruits. We seldom sat at the breakfast table, without having, previously, taken an inspection round through the stalls where fruits and vegetables were sold, and he was pleased to point out to me the rarest and most beautiful with a passing notice on their origin.

Mr. Michaux was extremely desirous to show me, in detail, his fine nurseries, especially those which contained his Maryland trees, to "*contemplate*" the result of the troubles and fatigues which they had cost me, but the weather was so unfavourable, during the whole season, that I could visit but one of

them, which I found wholly planted with Maryland Oaks, and covering an extensive plot of ground. Though the young trees, then devoid of their foliage, had suffered much, the second year, from the depredations of a herd of swine that had trespassed upon these grounds, they still appeared vigorous and promising, and are, I suspect, the very same trees that are now (as I see by the Paris papers) adorning the Quai des Tuilleries, and some of the new boulevards of the French metropolis, under the denomination of *American Oaks thirty-six years old.*

In acknowledgment of the service I had thus rendered him, Mr. Michaux presented me with a copy of the French edition of his magnificent work, beautifully bound in three volumes, and containing a double set of plates, the plain and the coloured.

Mr. Michaux's person was tall, strongly built; but not corpulent. His complexion was fair; he was slightly pock-marked, and possessed prominent features. His light blue eyes had a peculiar expression which startled me at first. His countenance was stern and cold on first approach; but it smoothed off and brightened gradually, as he spoke and became more familiar; his utterance, in the beginning somewhat slow and cautious, became rapid and impressive, and his conversation gay and even humorous. All his manners were quite simple and unaffected, frank and lively—they were altogether those of an open-hearted country gentleman, in whose presence, young as I was at the time, I could feel neither embarrassment nor shyness.

I do not think that, since this interview with Michaux, his position and pursuits underwent much change. To the very last day of his life, he was fortunate enough to retain his health and remarkable activity of body and mind. The main point of his arboricultural experiments, was to turn to advantage those lands, called heaths, which, in France alone do not cover less than two millions of acres, and were considered as utterly sterile. Through forty years of experiments, performed by him on the large demesnes belonging to the Central Society of Agriculture, and to Mr. Delamarre, he has ascertained that such lands could be improved and rendered productive by the cultivation of certain resinous trees, which succeed well in such soils. Of all the American and European pines with which he has experimented, Michaux gives the preference to the Russian Pine, *Pinus sylvestris*, which, in his letter to the President of the American Philosophical Society, above mentioned, he recommends warmly to the particular attention of the agriculturists of the Northern and Middle States of the Union.

With the view to remedy the scarcity of wood, under which this country is beginning to suffer, through the rapid and improvident destruction of the native forests, Michaux recommends also to the American people the cultivation of bushy or spreading trees, producing copses, or *Taillis*, to which he has applied a special mode of culture, more rational and more favourable to the development of vegetation, and, consequently, more profitable to the landholders.

We are informed by the same letter that Michaux was then preparing for publication a work in which he intended, succinctly, to develop his ideas on those interesting subjects, and to lay open the results of his observations and practical experience, for the particular benefit of the farmers and landholders of the United States.

Michaux's last days were thus passed tranquilly, dividing his time between his favourite occupations of arboriculture, and the society of a few friends, among whom the most intimate were President Seguier, Messrs. Macarel, D'André and Vilmorin. Louis Philippe himself, who had known him in this country, never ceased to show him the greatest esteem and affection. He was always happy to see some transatlantic acquaintance. All the Americans, who have seen him in Paris, or at his country residence of Vauréal, can testify to the urbanity of his manners, and to the cordiality with which he received his visitors. In conversation with Americans, nothing afforded him more pleasure than the subject of this country. He listened with amazement to the wonderful accounts of its progress, of the rapid increase of its population, of its wealth and resources, of its success in war and in diplomacy. The

names of new cities and innumerable towns, located on sites which, in his time, were still covered with the native forests; the mention of the multifarious rail-ways, extending their arms in all directions and encircling the whole country in an immense net-work of iron; the speedy steam travelling by land and water, which would have rendered his long and painful journeys so short and so easy; in fine, the electro-magnetic telegraph, another offspring of American genius—all these wonderful achievements elicited from him the greatest amazement and the most emphatic exclamations: Mon Dieu, Mon Dieu, est il possible!

He felt proud to mention that he had been one of the first steam navigators, and boasted of an early acquaintance with Fulton, whom he met at Albany in 1807, under the following circumstances: He was then returning to New York city from his exploration to the lakes Ontario and Erie, and intended to take passage in a packet boat for New York; but seeing an advertisement of a steamboat to depart the same morning, he had the curiosity to examine her, and he determined to take passage on her. Strange to say, he and a Frenchman who accompanied him, were the only passengers on board; it was the first trial trip. Fulton was on board, and, as might be supposed, between two such men, speaking equally well the French language, an intimate friendship was formed, which continued through life. The ardour of this friendship on Michaux's part, was proved by his devotion to Fulton's memory.

Michaux, having found in Paris a model, in clay, of a bust of his friend by Houdon, bought it and caused it to be put in marble by the best artist he could find, at the cost of 1000 francs. He obtained permission afterwards from the Government to have it placed in the Marine Department of the Louvre, near that of Papin, who had done, himself, so much for steam.

Michaux's turn of mind was also literary. Besides his great work on *the North American trees, his journey to the west of the Allegheny Mountains* and the memoirs already mentioned, he published, in 1831, an essay *on the Planera crenata;* in 1852, a memoir on the *causes of Yellow Fever in the United States*, and another one *on the culture of the Vine.* He may have left also, at his death, some unpublished papers, among which is probably the memoir alluded to in his last communication to the President of the American Philosophical Society. This communication dated, as I have said above, Vaureal near Pontoise, October 24th, 1852, was particularly intended to inform the President and his fellow-members that, desirous of giving the American nation a testimonial of his heartfelt gratitude for the hospitality and assistance which his father and himself had received in this country, during the course of their long and toilsome journeys, he had made testamentary provisions in favour of the Society, with the view to afford the means of promoting the progress of the science of Sylviculture in the United States.

This testament which Michaux had intrusted to the care of a gentleman of this city, Mr. Isaac Lea, whom he had consulted in the matter, was deposited four years ago in the archives of the Philosophical Society; but was not to be opened until after his death. This was done, consequently, on the 20th of October last, by the Recorder of Wills of the city of Philadelphia. By this document, he bequeaths to the American Philosophical Society, the sum of fourteen thousand dollars, for special purposes connected with the particular object of his constant aspiration, "The progress of agriculture with reference to the propagation of useful forest trees." By the same instrument, he likewise endows the Society of Agriculture and Arts of Boston, with the sum of eight thousand dollars for similar purposes.

Michaux's demise was made known to the American public by Prof. Asa Gray, in the columns of the July number of the American Journal of Sciences and Arts. It had been communicated to his lady, by a friend of Mr. Michaux, who thus relates the circumstances of his death: "I have to speak to you of the death of our good friend, Mr. Michaux. He was carried off with frightful suddenness by a stroke of apoplexy, on the 23d of October, 1855. He had been occupied the whole day, planting American trees, and himself directing his journeymen. He withdrew from his work in good health,

dined moderately, but with good appetite. He went to bed as usual, and fell asleep. At about one o'clock in the morning, his wife heard him move about and calling. She instantly rose from her bed, and ran to his apartment. He was still struggling on the floor, when she entered his room; but, on reaching him, she found that he had breathed his last. Physicians were called in immediately, but all in vain, life was totally extinct. He died at the age of eighty-five years.

Michaux left no issue. He had lived single to an advanced age, when quite suddenly, he became tired of celibacy, and changed abruptly his condition, by marrying a relative of his, who, for a long time, had been the manager of his house, his attendant in sickness and companion in his solitude. They lived most happily together, and at his death, he left her a comfortable provision for the remainder of her life. Mr. Michaux was in easy circumstances; but by no means rich. To his title of Chevalier de la Légion d'Honneur, he added, those of Correspondent of the French Institute, of Member of the American Philosophical Society, of the Central Society of Agriculture of Paris, of the Society of Agriculture and Arts of Boston, &c., &c.

TRANSACTIONS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

ARTICLE I.

ON ADIPOCIRE, AND ITS FORMATION.

BY CHARLES M. WETHERILL, PH. D. M. D.

THE formation of fat is interesting, both from a chemical and a physiological point of view. The relation of lignine starch and sugar to alcohol, afforded reasons for Liebig's theory of the formation of fat in the body. Recent experiments by Liebig, Bopp, Guckelberger, Keller and others, on the formation of the lower terms of the series of fatty acids by the oxidation and putrefaction of the blood-forming substances, rendered possible the formation of the higher members, from albumen, fibrin and caseine, by similar means,* for example, by a less intense degree of oxidation. It was thought that the study of adipocire, with a view to this question, would perhaps throw some light upon it; and upon reading all the articles within my reach, upon this body, from the time of its discovery by Fourcroy, I find a considerable difference of opinion with regard to it.

In 1785, Fourcroy examined a portion of a liver which had hung for ten years in the air in the laboratory of de la Salle; it was fatty, smooth, and unctuous to the touch. Potash ley dissolved a portion of the liver completely, forming a soap. Subsequently, when he had examined the fat of grave yards, and spermaceti, he proposed to name these three fats,

* Liebig thinks this probable. Ch. Briefe.

viz.: of biliary calculi, spermaceti, and from grave yards, adipocire, considering them to be identical, and possessing an intermediate nature between fat and wax. Chevreul, in his fifth Memoire, corrects this error, and calls the fat of gall stones cholesterine, and that of spermaceti cetine.

In 1786–7, Fourcroy had an opportunity of studying the fat of grave yards, in the removal of the bodies from the Cemetière des Innocens, a work which lasted for two years, and which was supervised by Dr. Thouret, who was placed there to care for the health of the workmen. The substance was abundantly found, and especially in the "fouilles," or ditches, where the slightly made coffins of the poorer classes had been piled one upon another; the trench being open for some time until it was filled with bodies, when it was covered with a slight quantity of earth; on opening the trenches after some fifteen years, the bodies were converted into adipocire; they were flattened by mutual pressure, and had impressions on their surface of the grave clothes. Fourcroy's analysis proved it to be a soap of ammonia, with phosphate of lime, and the fat, melted at 52° 5 C.* He supposed adipocire to arise from the putrefaction of all animal matter, except hair, nails, and bones, for he states that in the carcasses of all animals exposed upon the borders of pieces of water, a fatty, white, fusible substance resembling spermaceti is found.

Perhaps the earliest record on this change from flesh to fat, is to be found in Lord Bacon's Sylva Sylvarum, where he says, (article Fat,) "Nearly all flesh may be turned into a fatty substance, by cutting it into pieces and putting it into a glass covered with parchment, then letting the glass stand six or seven hours in boiling water." This may be a profitable experiment for making fat or grease; but then it must be practised upon such flesh as is not edible, viz.: that of horses, dogs, bears, foxes, badgers, &c.

George Smith Gibbes, 1794, observed that in Oxford, in the pits where were thrown the remains of dissections, and at the bottom of which flowed a gentle current of water, large quantities of adipocire were formed. He placed a piece of beef in the river in a box pierced with holes, and also a piece in which putrefaction in the air had commenced, and adipocire resulted in both cases. He proposes to make use of this property to utilize the dead bodies of animals, and states that nitric acid will effect the same change in three or four days.

John Bostock (Nicholson's Journal, March, 1803,) digested muscular fibre with dilute nitric acid, and washed with water: the result was a clear, yellow fat, of the consistence of tallow, melting at 33° C. Is less soluble in alcohol than Fourcroy's substance: the greater part deposits nearly white on cooling, and the residue can be precipitated from the alcohol by water. Hot ether dissolves it and abandons it on cooling; caustic alkali forms a soap; ammonia dissolves but little of the fat.

* The degrees of thermometer in this article are centigrade, and the weights grammes.

Chevreul, on repeating this experiment with pure fibrine, could obtain no fat. Hartkol, (Ure's Dict. art. Adipocire,) experimented for twenty-five years on adipocire, and concluded that it is not formed in dry grounds, that in moist earth the fat does not increase, but changes to a fetid mass, incapable of being made into candles. Animals in running water leave a fat after three years, which is more abundant in the intestines than in the muscles, and more fat is formed in stagnant, than in running water.

Chevreul, 1812, found the fat of church yards to contain margaric and oleic acids, combined with yellow colouring and odorous matters, also lime, potash, oxide of iron, lactic acid salts and azotized matter. He supposes the fatty acids are liberated from their glycerine by ammonia, which subsequently itself escapes, and that adipocire is thus formed from the original fat of the body.

Gay Lussac, (An. de Ch. et de Ph. iv. 71,) adopts the same views. He subjected finely chopped muscular fibre deprived of its fat by ether, to the action of water, and did not succeed in forming adipocire.

Von Bibra, (Annalen der Chem. und Ph. 56, p. 106,) in an examination of the flesh of the leg of a Peruvian mummy, a child, obtained 19.7 per cent. of fat, which he supposes to have been formed from the muscles. In comparison, dry human muscle from several analyses by himself, gives nine per cent. of fat. The muscular fibre of the mummy, after treatment with ether, presented the same appearance under the microscope, as fresh muscle placed in the same circumstances. Bibra states in the same article, that he is fully convinced of the change of muscle to fat, having obtained a human corpse in which all the parts of flesh were nearly wholly converted into fat.

Blondeau, (Comptes Rendus, Sep. 6th, 1847, and Ch. Gazette, same year, p. 422,) arrived at the same conclusion from an examination of the Roquefort cheese manufacture. This cheese is placed in dark, damp, cool cellars to ripen. Before this treatment, the cheese contained $\frac{1}{200}$ of its weight of fat, and after two months in the cellars the caseine was almost wholly converted into a fat, which melts at 40°, boils at 80°, and decomposes at 150° C. The unaltered caseine could be removed from it, by mere melting with boiling water. In an additional experiment, a pound of beef free from fat was slightly salted, surrounded with paste, and placed in a cellar; after two months, it had undergone no putrid decomposition, and was converted, for the greater part, into a fatty body, presenting the greatest analogy to hog's lard. In these instances a number of parasite plants are observed on the material, and it is necessary to scrape the cheese from time to time, to free it from these mycodermic plants, which are reproduced with fresh energy. As these plants require ammonia for their development, Blondeau supposes it can only come from the nitrogen of its caseine, and that fat is one of the results of the caseine decomposition.

Gregory, (Annalen der Chem. und. Ph. 61, p. 362,) examined the adipocire of a fat hog

which had died of sickness, and had been buried for fifteen years in moist ground; at the bottom of the grave was the adipocire in a layer hardly an inch in thickness; it contained ¼ stearic and ¾ margaric and oleic acids, together with from 1. 5 to 3.5 per cent. lime. The glycerine was all gone, and so was the bone earth, which together with the flesh were removed, as Gregory supposes, by the carbonic acid of the rain water, leaving the original fatty acids of the body.

Prof. Hünefeld, (Jour. für Pr. ch. 7, p. 49,) examined a loaf of rye bread, which had been buried for at least eighty years in a turf-moor, and found 2.2 per cent. of a waxy or fatty substance, and he refers to an examination by Bracconot, of a mouldered wheat bread containing, among other substances, a fatty body. Hünefeld supposes that the substance of the bread was displaced by the turf material, the form of the loaf being retained; and admits the possibility of the bread substance partaking in part a change into resin and waxy humus.

R. Wagner, (Ch. Gazette, vol. 9, p. 306,) transplanted the recently removed testicles of rabbits and frogs into the abdominal cavity of fowls; the testicles of fowls into other fowls and pigeons, those of pigeons into fowls, and fresh crystalline lens into fowls and pigeons which were killed after ten or fifteen days. The testicles of frogs contained three per cent. of fat, which was augmented to 5.15 per cent. In one case the crystalline lens, after the experiment, contained 47.86 per cent. of fat; in a number of other experiments on lenses, the result was of from 7 to 15 per cent. of fat, calculated for the dry substance of the lens; carefully cleaned portions of frog intestines filled with coagulated blood of pigeons and calves, fat free muscle from the thigh of a frog, and boiled white of hen's egg, in similar conditions, all gave fat.

These experiments were repeated by Husson and Burdach,* enveloping the nitrogenized substances in bags or coatings of gutta percha, caoutchouc and collodion. They found the substance well preserved, but no change into fat; so that admission of the animal juices must conduce to it, if the change be possible. Burdach placed porous vegetable substances, as wood and tinder, in the abdominal cavity, and found a deposit of fat on them, and which was imbibed in the pores, which speaks against the change in question. Finally, Burdach determined the fat of the egg of *Linnœus stagnalis*, and detected a considerable increase of it during the development of the embryo; but, on the other hand, the egg contains sugar from which the fat could have been formed; and in opposition to this the quantity of sugar in hens' eggs has been noticed rather to increase than diminish during incubation.

Quain & Virchow quoted by Lehmann,† examined muscle changed in macerating troughs to adipocire, and are of opinion that the fibrine is here changed to fat. I have questioned

* Lehmann, Lehrbuch. † Lehrbuch, III. p. 187.

my medical friends, who have had experience in this matter, and find them to hold the same opinions. Prof. Leidy, who macerated with water the bodies of small animals, in stoppered bottles, to obtain their skeletons, found that the deposition of adipocire upon the bones was quite abundant.

The physiological question of the formation of fat, has been fully discussed within the past ten years, and it has been proven by diet and analysis, that herbivorous animals possess more fat than is taken in their food; but whether the fat be formed wholly from non-nitrogenized or from nitrogenized bodies, or partially from both, is yet undecided. Pathological considerations from the fatty degeneration of several of the organs, where the fat is found both within and without the cell,* appear likewise to have divided scientific men as to its origin, whether from a change of the proteine compounds of the organs, or from an abnormal plastic activity. The connexion of the organs of generation with the deposit of fat, and the increase of the latter after castration, is worthy of consideration; for the cutting off the supply of the highly albuminous semen, gives an impulse to the fat formation. The flesh and the fat of the body stand in an intimate relation to each other, and neither the non-nitrogenized nor the nitrogenized diet exclusively is conducive to health. *Repose* is necessary, (with a proper diet,) to the formation of fat, and as the activity of the muscles requires their reparation from the food, perhaps it is as much this wearing away by activity, that hinders the formation of fat, as the increased combustion by the quickened respiration. It therefore appears to me probable that both classes of food conduce to the fat formation.

It was thought that the study of adipocire would throw some light upon the question, whether fat be formed from proteine compounds, and I was surprised to find the great difference of opinion as to the formation and nature of this body, and in general, as to the changes that bodies undergo in grave yards. These various changes are ascribed by undertakers to the nature of the soil, to its dryness or moisture; but in a late removal of a grave yard in this city, some bodies were found converted into adipocire, the graves of which were contiguous to those in which decomposition had advanced to its full extent, leaving nothing but the skeleton. The preservation of some bodies seems inexplicable, according to our present knowledge, of which I may cite the well known case of General Washington, (who was not embalmed,) who having reposed in his tomb for more than forty years, was so perfectly preserved, as to have been recognised from the resemblance of his portraits. The problems proposed for this research were:—

1st. The chemical examination of different kinds of adipocire.

2d. To watch the decomposition of flesh with water, and imitating the condition of a body in moist ground.

* Lehmann.

With regard to the first of these, I possessed the following specimens of adipocire:

(*a*) Two from sheep buried at the country seat of the late J. P. Wetherill.

(*b*) Two from human subjects, which I obtained myself from a grave yard.

(*c*) From a fossil ox, presented by Prof. Leidy.

(*a*) SHEEP ADIPOCIRE.

Specimens of this adipocire were presented to the Academy of Natural Sciences, by my uncle, who found them at his country seat, opposite Valley Forge, buried in moist ground, near a drain which led water from a spring-house. About ten years previously, the shepherd in charge of a flock of sheep indulged in a drunken spree, and in the meanwhile some fifteen of the sheep in his care died from neglect, and were buried in the above mentioned spot. My uncle, who was present at the exhumation of the sheep, stated that in some of the remains, the exterior forms of the muscles were very distinct. The two specimens I obtained were in lumps, amorphous under the microscope, floating on water; of greasy feel, and rank mutton smell, mingled with a peculiar disagreeable fundamental smell, that I have observed in all my specimens of adipocire, including the fossil one. Heated in a capsule with water, a transparent fat floats melted on the surface; heated alone in a platinum crucible, it melts and burns with a smoky flame, leaving a slight residue, which effervesces with hydrochloric acid, and contains beside sand and a little iron, principally lime. Under the microscope with moderate powers, it is white, fatty, and granular, disappearing with Canada balsam; with higher powers it is amorphous: melted on the glass slide covered with thin glass, is crystalline on cooling, in groups of plumose crystals, which give a beautiful play of colours with polarized light; a drop of its weak alcoholic solution evaporated spontaneously on glass gave the same appearance of crystallization. Water added to this solution precipitated it in the form of a pure white amorphous powder: distilled per se, leaves a slight carbonaceous residue, and gives a volatile fat, yellowish, and cryst, on cooling. This volatile fat is soluble in hot alcohol, and precipitates partly on cooling. The weight of material was seventy grammes; it was melted in the water bath, and filtered through paper in a hot funnel; the filtered solidified fat was of a light coffee colour, and weighed fifty-four grammes; in a capillary tube, is soft at 54°, fluid at 62°; on cooling becomes opaque at 50°. When pressed in paper, the latter is greased by oleic acid; it contains no ammonia, nor any nitrogen by the potassium test; the residue on the filter (together with the filter) was boiled with alcohol, filtered hot on a weighed filter, and washed with alcohol. This alcoholic solution deposited twelve grammes of fatty acid, by spontaneous evaporation, during the summer. The crystals at first deposited were white and warty; a portion of the alcoholic solution on a glass slide, exhibited with the microscope, white, curved dendritic forms, arranged stellate; in the capillary tube, they begin to melt at 53°,

are fluid at 62°, and on cooling begin to cloud at 58°, and are opaque at 50°. The residue on the filter weighed about four grammes, and viewed under the microscope, consisted of membranous matter, wool, dirt, and the white element of cellular tissue; it gave ammonia with potassa solution, and nitrogen by Laissaigne's test, together with a strong smell of phosphuretted hydrogen when the water was added in the latter test. This residue burned, gave thirty per cent. of ash. The following is the per centage result for the adipocire:—

Solid fatty acids, a little oleic acid, and coally matter,	94.2
Membranous matter and cellular tissue,	2.3
Ash and dirt,	3.5
	100.0

The portion of fatty acid which passed through the filter by melting, contained 0.73 per cent. of a dark-coloured ash, principally lime, with iron, and traces of phosphoric and sulphuric acids, potash and soda. The potash and soda were detected by Dr. Lawrence Smith's beautiful method by polarized light, which I have frequently used with success. In this instance, the quantity of material was so small, that neither the potash nor soda could be detected by the usual method.

[An experiment was tried to ascertain whether the fatty acids would dissolve phosphate of lime. About six or eight grammes of fatty acid, (the residue from the hot press of the candle factories, crystallized from much alcohol, and of which one gramme left no appreciable ash by experiment) were kept for half an hour melted with pulverized bone ashes. One gramme of this gave an ash of only a quarter of a milli-gramme; when this was dissolved in hydrochloric acid and neutralized by ammonia, it was impossible to conclude whether there was a precipitate or not.]

Sixty grammes of the fatty acids were then saponified with potash ley, according to Chevreul's proportions, during which operation neither ammonia nor cholesterine could be detected. The soap was decomposed by tartaric acid, and washed several times by melting with water; it dissolved thus in alcohol with reddish brown colour, and after filtering hot, was suffered to deposit the greater part of its fat on cooling. The crystals thus deposited were nacreous scales, and of lustre like the feathers of moth wings; when melted, they weighed 26 grammes, and had a goat-like smell; by further standing, the alcohol deposited four grammes of very translucent crystals, with traces of stellar groupings. A third crop of crystals by spontaneous evaporation was obtained, which was small in quantity, weighing 0.6 grammes, and, when melted, cooled with a flat, waxy, surface, with traces of stellar aggregations. The mother alcohol of this last crystallization, was treated with an alcoholic solution of acetate of lead. The lead salts, treated in the usual manner by ether, yielded a few drops of very highly coloured oleic acid. From the insoluble lead salts, the fat was separated.

The alcoholic solution from which the oleate and other lead salts were precipitated by acetate of lead, was evaporated to dryness, and treated by ether, when another portion of oleic acid was obtained. It results from this that the quantity of oleic acid in the adipocire is small. The greater portion of the lead salt was insoluble in ether and alcohol, its fat was separated and added to the first crop of crystals which fell from the alcoholic solution of the fat from saponification. To ascertain whether any glycerine was in combination with the fatty acids in the adipocire, the aqueous solution from which the crop was precipitated by tartaric acid during the purification of the fat, was heated, filtered from small fat globules, and after removing the tartar deposit, subjected to distillation. The acid residue of the retort was neutralized by carb. potash, and after evaporating on the water bath was exhausted with absolute alcohol, which proved the absence of glycerine, as it gave on evaporating nothing but a small residue of colouring matter, which was yellow, and of a bitter taste.

The distillate in this experiment had a goat-like smell, and it was doubtful whether it reacted acid to litmus paper. Baryta water was added to alkaline reaction, for which but a small quantity was needed, and the solution evaporated. There was but little residue, which, on the addition of a drop of hydrochloric acid and water, emitted a rancid smell, but no oil globule appeared; the volatile fatty acids may, therefore, be considered to be present in the adipocire only in faint traces.

The following melting points were obtained:—The first crop of crystals from the alcoholic solution of the fat after saponification, which, when melted, cooled with a stellated surface, tried three times by dipping the thermometer bulb in the melted solution, and noting the temperature when it became opaque, gave 55° for the solidifying point. In a capillary tube, begins to melt at 57°, fluid at 59°, on cooling, opaque at 55°; this portion was taken from the capsule on melting the fat, before the whole mass was melted: another portion taken when all was fluid, and after stirring, gave the same results.

The crystalline appearance of the second crop of crystals from the alcoholic solution after saponification, when melted and suffered to cool in a capsule, is similar to that of the first crop; in the capillary tube, begins to melt at 53°, fluid at 54° 55°, on cooling, crystals form in the tube at 51°, and is opaque at 50°. The melting point of the third crop of crystals was 50°.5. In ascertaining the melting points of the different fats described in this paper, I tried the various modes in use, and settled at first upon the following:—A beaker of distilled water (which must be boiled just before using, to prevent air globules settling upon the capillary tubes, which would falsify the result) is placed upon wire gauze upon a retort stand in front of a window, the thermometer hangs, by a string, in this water from another stand, and the lamp must be moveable from under the beaker glass. A piece of string is tied so loosely around the top of the (cylindrical) mercury

reservoir of the thermometer, that the different capillary tubes may be readily slipped in and out on raising the thermometer from the water; the heat from the lamp must be such that the temperature of the water rises gradually; the capillary tubes are so placed that they lie closely to the mercury of the thermometer, and when the temperature approaches the melting point, the water is stirred with the thermometer to equalize the heat, the lamp is then removed, and the point of solidification observed in the usual way. I doubt very much the use of noting the point of solidification, as it is influenced so much by extraneous circumstances. The cooling of water and certain salts below their solidifying points, is well known, and the same must take place in these instances. Heintz has noticed how the thermometer rose ten degrees in determining the solidifying point of melted human fat. In one of my experiments, the fat in the tube was separated by minute air globules into three or four columns, quite close together; in observing the fusing point, they all melted at the same instant; but in solidifying, one would be quite clear while those on either side had become opaque, no matter how much the tube was stirred or vibrated by striking the beaker glass. After having observed this in several instances, I abandoned taking the points of solidification, and modified the process for the fusing point, by keeping the water as near that point as possible, and repeatedly lifting the thermometer and attached capillary tube out of the water for a few seconds, that the fat might solidify, and noting the fusing point as that at which it at once becomes liquid; this point is reached twice; first, when the water is being heated, and secondly, as it is cooling: I have found by repetition of the same experiment, that the degree thus obtained, is constant from the first, and I think gives the most accurate results. The mode of using capillary tubes for the fusing points, is convenient, as, at the close of the experiment, they can be sealed at the open end, and placed on a card with descriptions, for future reference. I weighed the quantity of fat in one instance, and found that half a milligramme was much more than enough to obtain the melting point with the capillary tube.

(*b*) HUMAN ADIPOCIRE.

Towards the close of the year 1853, I visited a grave yard in Philadelphia, the remains of which were being removed, and from which, through the kindness of the superintendant, I obtained specimens of adipocire and valuable information. The surface of the burial ground was depressed about four or six feet below that of the neighbouring streets, and was of a very moist nature. Many of the bodies were converted more or less into adipocire, and of these, all had been large persons. There was none among the remains of children. I obtained specimens from two persons.

No. 1, was from a large man, which had been buried from ten to fifteen years; the

ground was very moist, and the coffin rotten; the grave was seven feet deep. The adipocire was from the middle of the coffin, and was in irregular lumps.

No. 2, was from a very large man; buried five or six years; the ground moist, though not so much so as number one; the grave five feet deep. The ground around the coffin was of a bloody colour, and all of the body was decayed, except the lower portion. The shape of the rump was plain, and the legs separate; the fat was at the bottom of the coffin, and the bones (femur, tibia) were lying along it. The adipocire contained an impression of the bone, was spongy and dark-coloured on the inside; and on the outside it was smooth, white, and presented impressions of the grave clothes, and here and there appearances as if of the hair follicles and sebaceous glands, but which lost this appearance when viewed with the microscope. There was no hair on this specimen. The pieces of adipocire of this specimen were large, at the thickest part being about three inches in thickness; they presented the shape of different parts of the leg, though flattened; tough fibrous bands, like aponeuroses, were seen in some parts traversing the mass of fatty matter.

The appearance of these two specimens with the microscope, was very similar to each other and to the sheep adipocire. Powder scraped from them, with a fine needle, gave no appearance of fat globules, but irregular masses, mingled with membranous matter; a portion sliced off with a sharp knife, presented by reflected light, brilliant, white, irregular fatty fragments, but no traces of globules. When alcohol was added with heat, the fat disappeared, leaving membranous matter, and fibres not-anastomosing (the white element of cellular tissue.) The addition of acetic acid causes the fibres to disappear, and without showing nuclei.

Portions of number one presented an appearance as if of the hair follicles, and there were mingled with it cylindrical hairs, of an inch and a half in length, brownish in colour, and quite fine. From these hairs, and from its position in the coffin, adipocire number one probably came from the abdomen. The fat from this portion gave the same appearance under the microscope, as specimen number two. The alcoholic solution of the fat evaporated on the microscope slide, gave the appearance of stellated dendritic crystals, with curved branches, resembling the so called margaric acid under the same circumstances.

The whole mass of fat in the two specimens, seems to be entangled in a web of disintegrated membrane, and fibrous tissue. I have never been able to detect any traces of muscular fibre under the microscope; and Dr. Leidy, who was kind enough to examine specimens with the microscope, communicated to me the same results. The smell of the two specimens was peculiar; what might be called an adipocire smell; for I have observed it in all specimens of adipocire that I have examined. This smell is indescribable, the nearest approach to it being that of fæces, but it is much more disagreeable.

The following melting points were observed from the original adipocire, melted per se in

watch glasses, and the fat taken up in capillary tubes. In these specimens, (*a*) was taken from parts with *little*, and (*b*) from parts with *much* cellular tissue:

No. 1.	(*a*)	fuses at 56°	
		solidifies 50°	
	(*b*)	fuses 50°	
		solidifies 43° 44°	
No. 2.	(*a*)	fuses 55°	
		solidifies 50°	
	(*b*)	fuses 55°	
		solidifies 50°	

They commenced to melt a little below and to solidify a little above these points, which were taken for perfect fluidity or opacity. Generally in solidifying, the crystallization commenced at one point, and spread gradually through the capillary tube.

The density varied with different portions of one and two, from below 0.7487 to 1.0, and was ascertained, by immersing specimens (freed from external air globules) in ether of the above density, alcohol of density 0.8365, and distilled water. The ash, no doubt, varied also; but the following determinations were made with the whitest portions of one and two: viz.: those of the density of ether. No. 1, contained 0.573 per cent. of ash, (1.135 gave 0.0065) which effervesced with acid, and contained principally, lime, with traces of chlorine, sulphuric and phosphoric acid, also iron, potassa soda, and (doubtful) magnesia. The melting point of this portion was 52°, 53°. No. 2, gave 0.18 per cent. of ash, (1.109 gave 0.002) which contained the same substances as number one. The melting point of this fat was 53°, 55°.

The two specimens of adipocire were melted with about one and a half times their weight of ordinary alcohol, filtered hot, washed a couple of times with hot alcohol, and pressed, the residue being weighed. This gives an approximate per centage of the membranous and fibrous matter, which is rather too low, owing to a little fat remaining in the residue and filter. The specimens of adipocire were picked as far as practicable from dark pieces.

No. 1, 360 grammes, gave nine of residue, or a per centage of

Fat colouring matter and water, . .	97.8
Organic tissue, ...	2.2
	100.0

No. 2, 997 grammes adipocire, gave twenty-seven residue, or per cent.

Fat colouring matter and water, . .	97.3
Organic tissue, ...	2.7
	100.0

The fats were then saponified with Potassa; No. 1 by Chevreul's process, and No. 2 by Heintz's process with alcohol. The soaps were precipitated several times, by solution of common salt; no ammonia nor cholesterine were detected during the process; a heavy, flocculent soap fell during the melting, which was examined, and found to be a soap of alumina, oxide of iron and magnesia; probably from impurities in the salt. No glycerine was present (by direct experiment) in either of the specimens. An examination for volatile fatty acids, gave negative results for number one, and a very slight trace in number two of volatile fatty acids, acetic and butyric, and one or two minute floating oil drops, most probably from the alcohol employed.

The fats thus obtained, were very dark in colour, and when cooled, after being melted in a capsule on water, solidified with a smooth, waxy surface, with the fibres of crystallization vertical. At the point of crystallization, the expansion pushed up, and broke the soft cake of fat in the centre. No. 1 weighed 237 and No. 2, 644 grammes.

No. 1, (the melting point of which was 57°5, the solidifying point 52°) was melted with an equal weight of alcohol, and on cooling, filtered and pressed; a very dark liquid ran through, a drop of which, evaporated on a glass slide, gave dendritic, stellate, polarizable crystals. To the residue weighing 177 grammes, 100 grammes of alcohol were added, and the fat which separated, together with some depositing from the last filtrate by standing, were added to the fat of the previous operation; the fat which separated from this solution of 177 grammes, melted at 59°–60°, and solidified at 53°–54°. The dark-coloured alcoholic liquid, filtered from these fats, was saponified by an alcoholic solution of potassa; the alcohol expelled by boiling with water, and after transferring to a retort, was boiled with sulphuric acid. The distilled water, examined for volatile fatty acids, gave negative results. The fat was very dark in colour, melted at 55°, and solidified at 50°, though it was difficult to determine these points exactly, as the change exhibited itself very gradually. A portion of this fat was converted into a potassa salt, and precipitated by chloride of barium; the filtrate from which, treated with hydrochloric acid, gave a small quantity of a yellow fat, not further examined.

The baryta salts were treated by ether, and the residue by boiling alcohol. The ethereal, alcoholic solutions, and the residue, were severally decomposed by hydrochloric acid. The ethereal solution gave a small quantity of oleic acid, in very dark drops. The alcoholic solution fat was also small in quantity, and dark. It fused at 61°–62°, and solidified, as well as could be judged, at 45°. The residual fat, which was the largest in quantity, yellow, and of a waxy surface, melted at 43°–46°, and solidified at 45°–40°.

The purification of fat No. 2, was now undertaken, and experimented upon more particularly than No. 1, since this specimen of adipocire conformed to the shape of part of the human frame.

1°. An equal weight of alcohol was added, and the fat, which weighed 644 grammes, was dissolved by heat; on cooling it was pressed, and as the filtrate deposited more fat on standing, it was pressed again, and the fat added to the former. The dark-coloured filtrate was bottled, and the fat melted. It was of smooth and waxy surface, and weighed 511 grammes.

2°. The fat from 1° was melted with 170 alcohol, and the same operation performed. Residue weighed 327 grammes.

3°. Added 124 alcohol to this fat. In this all the liquor was absorbed by the pressing cloths; the fat weighed 335 grammes.

4°. Added an equal weight of alcohol and melted; pressed after two days. The liquid by this time, was light yellowish; the fatty crystals in white flakes or scales; the smaller ones transparent under the microscope, and polarizable. A portion of the fat was melted, and observed cooling under the microscope with polarized light; as the solidification approached, a beautiful play of prismatic colours took place, and the drop shot into crystal interlaced lamellæ. A drop melted with alcohol, and let cool, gave the peculiar dendritic curved appearance of margaric acid.

5°. The fat by this time weighed 300 grammes; it was melted with an equal weight of alcohol, and pressed the following day. Residue, 253 grammes.

6°. This was melted with 250 alcohol; the liquid from the press was very little less coloured than the last; the residue weighed 227 grammes, and was brilliant white, with a tinge of yellow; the fracture showed large crystals, and could not be distinguished from the product of the stearic candle factories. When melted, it cooled with raised, uneven surface, and was completely soluble in ether. When the ethereal solution was suffered to separate spontaneously, the first fat which made its appearance melted at 60°, solidified at 55°, and the fat extracted from the rest of the ether gave exactly the same points.

The following are the melting points yielded by the fatty residues of the foregoing alcoholic crystallizations:

Fat 2° . . .	melts 58° . .	solidifies 53°
" 3° . . .	" 58° . .	" 53° a 52°
" 4° . . .	" 58° . .	" 53° a 52°
" 5° . . .	" 58° a 58° 5 .	" 53°
" 6° . . .	" 60° . .	" 55° 54°

The examination of the liquids separated from the above crystallizations, was now taken up. Their colour was from a very deep reddish brown (No. 1°) down to light yellow, and nearly colourless (No. 6°.) In 1°, 2°, and 5°, crystals had deposited by standing, and as 2° was not corked like the rest, the deposit here was abundant; it was re-melted with addition of as much alcohol as had evaporated, and was suffered to stand for several days

longer, when a drusy crystalline deposit made its appearance. The following are the melting points for these two precipitates:

Precipitate in 1° . .	melts 62° 63° . .	solidifies 44° 5—40°
" " 5° . .	" 51° 55° . .	" 44° 5—43°

The fat deposited in 2° melted at 58°, and solidified at 52°, and the fat separated from the *liquid* of this bottle, melted at 59° 5, solidified at 53°, but continued translucent down to 33°. After the above melting points, 1° and 5° were observed, the same fat was raised slowly to the melting points, and then kept for a considerable time in the thermostat, at 100°, the points were again determined, and found to be the same.

The liquids separated from the fats 1°—6°, gave the following results:

The fat from Liquid 1° . .	melts 36°—46° . .	solidifies 41°—?
" " 2° . .	" 39°—41° . .	" 37°—35° 5
" " 4°* . .	" 59°—62° . .	" 40° 5—35°
" " 5° . .	" 62°—66° . .	" 58°—53°
" " 6° . .	" 53°—56° . .	" 41°—?

The melting point of liquid 2°, does not accord with that above stated, but I note the experiments as they were observed, merely mentioning that I observed carefully, and am not conscious of having made an error. The above points seem vague, but it was impossible to fix a point definitely, as a cloudiness persisted up to the highest degree stated, so I prefer to give the limits of certainty. In 1° and 6° the solidifying points, 41°, were taken when the liquid in the capillary tubes seemed to become solid, but it remained translucent for a long time below this point, and 6° only became opaque (and that gradually) when suffered to stand in the air.

We are reminded here of Duffy's observations upon certain isomeric transformations of the fats, (Quar. Jour. Ch. Sec. V. 197.) He noticed that stearine heated 1° above its point of solidification, became transparent, but soon after resumed its opacity; and Heintz made a similar observation. Duffy attributes this to an isomeric transformation of the fat by the heat; but it seems to me simpler until an isomerism be more distinctly proven, to assume a mixture of fats, which unite to form a definite compound under the circumstances, and which has the above mentioned property.† Heintz's researches on the fats should make us look with suspicion upon fats as pure, that are only purified by crystallization.

* The liquid from No. 3 was all absorbed by the pressing cloths, and not collected.

† Since the above was written, I have received the Journal für Pract. Chemic., Heft III. Band LXIII. in which some late results by Heintz on this point are communicated. He artificially prepared chemically pure stearine from the acid and glycerine, by Berthelot's process, and found that it had two melting points, first at 55°, then solidifying and melting again when the heat reached 71° ·6.

Duffy's remarks were made upon the glycerine compounds of the fatty acids; it appears from the above examination of the liquids 1° and 6°, as if something similar took place with the fatty acids themselves, although, with one or two exceptions, in other determinations of melting points noted in this article, I have not observed the same phenomenon of transparency.

A few experiments were now made with the alcoholic liquid 6°. A concentrated alcoholic solution of acetate of magnesia added to this liquid, produced no precipitate, but micaceous crystalline scales fell on adding acetic acid, and upon adding more acetic acid, and heating, besides these crystals, an oil floated on the surface, which solidified on cooling, and which behaved like a fat, and gave the melting point of palmitic acid, viz.: 62° (solidifies gradually from 47° to 39°.) The crystals gave a small quantity of ash when burned on platina foil, and on being decomposed by hydrochloric acid, gave a fat with the melting point of stearic acid 72° 73°, and solidifying at 60° 55°. The mother liquid contained too little fat to experiment upon. To another portion of the liquid 6°, alcoholic acetate of magnesia was added without addition of acetic acid, and the solution evaporated in a retort. The first crystals which appeared contained a fat which fused at 65°, 68° 5, and solidified at 62°, 58°.

The solid crystalline fat No. 6° which was removed from the liquid 6°, and which was the most highly purified result from the crystallization of this specimen of adipocire, was now examined more particularly; an alcoholic solution was made upon which to try the different experiments. Fifteen grammes of the fat required 300 of alcohol of 93 per cent. to keep it in solution; but before having added so much alcohol, on standing for a short time 0.656 grammes of pearly crystalline scales fell, which had a melting point of 62° 5, and solidified at 55° 5. The fat of the liquid after these crystals had fallen, when precipitated by water, melted at 58° 61°, and solidified at 55° 5: these crystals, re-crystallized from alcohol, melted at 62° 5, and solidified at 58°, 57°; these were dissolved a third time, in twenty times their weight of 93 per cent. alcohol, which deposited, on standing, less than a milligramme of tufted crystals of the form of palmitic acid, of which it had the melting point 62°: more alcohol was added to the solution, and it was divided by fractional precipitation with acetate of magnesia and the addition of a little ammonia with heat, into two portions, weighing 0.256 and 0.164 grammes, and they had the same melting point. This fat appears, therefore, to be palmitic acid, one of the acids into which Heintz divided margaric acid. The crystals deposited from alcohol do not at all resemble those of margaric acid, but under the microscope are lamellar. These two fats were converted respectively, by an excess of nitrate of silver, into silver salts, 0·24725 gave 0·074 Ag. = 29·93 per cent. and 0·14275 gave 0·04175 Ag. = 29·25 per cent., which corresponds to the percentage of silver in the palmitate of this base.

		By calculation.	Mean of two Exper.
C_{32}	192.00		
H_{31}	31.00		
O_4	32.00		
Ag.	107.97	29.7	29.5
	362.97		

There is no doubt, therefore, of the presence of palmitic acid in the fat of human adipocire. The second crop of crystals which fell from the mother liquid of those just examined, contained a fat melting at 62°, in all probability palmitic acid also. A determination of the silver of the salt of this fat was lost in the following curious manner: The silver salt was in lumps, as it had dried on the filter, and after it had stood for a short time at 100 in a watch glass, thinking to facilitate the escape of water, by pulverizing it in an agate-mortar, it became so exceedingly electric, that of the whole quantity of silver salt from 0.651 grammes of fat, I was not able to collect the smallest portion for analysis; whether the powder was attempted to be removed by steel, platinum, glass, a feather, or paper, on the first touch it flew into the air, and alighted upon the table: I have often noticed this behaviour in organic silver salts, and perhaps it would be worth while to try whether one of them could not favourably replace the amalgam on the cushion of the electrical machine.

The following experiments were made upon the alcoholic solution of the fats, from which the above portions of palmitic acid were separated. Enough alcohol was added to this solution to prevent any further deposit by standing, for which, as was before stated, 300 alcohol were required for 15 fat. Its percentage of fat was determined by evaporating the alcohol from a known quantity, and weighing the residue; the melting point of this fat was 60° 5 to 61°. This melting point was again determined after saponification, to ascertain whether a fatty ether might not have been formed, and was found to be the same. The alcoholic solution of acetate of magnesia was also titled so that the necessary quantity might be added to the fat solution by measurement: the fat under consideration should be, by Heintz's experiment, a mixture of stearic and the so called margaric acids, together with impurities.

Before proceeding to the fractional precipitation by acetate of magnesia, the alcoholic fatty solution was treated with an excess of acetate of magnesia, and an excess of acetic acid (aided by a little warmth) added; the resulting liquid was then evaporated over sulphuric acid (removing the crystals as they formed) in order to ascertain what effect this treatment would have upon the melting points. On cooling, a small quantity of a powdery precipitate fell, and after standing for a couple of hours over sulphuric acid, the liquid crystallized rather suddenly, to plates or scales, the melting point of which, after treatment with acid, gave 62°; recrystallized from hot alcohol it melted at 62° 5, 63°.

precipitate the whole, was added; to the filtrate an excess of the magnesia solution was added, and the fat remaining in the filtrate from this precipitation was separated, as was also that of the other two precipitates. The following results and melting points are in their order as determined:

(*a*)	0·351	melts 61°
(*b*)	0·527	" 61°
(*c*)	0·085	" 53°
loss	0·173	
	1.136 grammes.	

(*a*) and (*b*) were united, dissolved in alcohol, enough alcoholic solution of acetate of magnesia to precipitate the half added, and after standing for a couple of days, the precipitate was filtered off, and ammonia added to alkaline reaction to the filtrate. The first magnesia salt was translucent, and fused by heat to a transparent liquid, which by more heat gradually grew darker, finally black, and left a residue of magnesia. The melting point of the fat of this substance was as before, 61°.

The second magnesia salt was white and amorphous; it presented the same relations to heat as the first, and contained a fat of the same melting point, 61°. These fats were both brilliant white, lamellar, and of rough surface. The first magnesia salt contained a per centage of 7·59 MgO (0·25025 gave 0·019) and the second contained about double the per centage of magnesia, viz.: 14·91; for 0·28 salt gave 0·04175 magnesia by incineration.

Neutral palmitate of magnesia C_{32}, H_{31}, O_3 MgO gives by calculation 7·6 per cent. magnesia, and basic palmitate C_{32}, H_{31}, O_3 2 MgO gives 14·15 magnesia, which approaches the nearest to the magnesia salt of the above fatty acids.

The experiments of fractional precipitation of the normal solution of fat 6°, were conducted in the same manner, and with the following results, in which (*c*) and (*d*) represent the fatty acids of the two magnesia salts, and (*e*) that of the portion not precipitated by an excess of acetate of magnesia:

(*c*)	0·474	melt pt. 59° 5
(*d*)	0·440	" 61° 5
(*e*)	0·356	" 58° 5
loss during the ex.	0·010	
	1·280 grammes of fat.	

The magnesia salts from which the fats (*c*) and (*d*) were separated, gave as follows:—(*c*) 0·227 gave 0·01675 = 7·38 per cent. magnesia; and (*d*) 0·1735 gave 0·012 = 6·92 magnesia. On comparing the melting points of these fats, and making allowance for want of a more perfect separation from impurities, there can be little doubt that they are neutral palmitates of magnesia, as was before ascertained. According to Heintz (Zoochemie,

p. 1072,) stearic acid is C_{36}, H_{36}, O_4, and the magnesia salt contains by calculation, 6·9 per cent. of that base. The foregoing experiments upon the two specimens of human adipocire were intended preliminary to a more thorough research into their nature, by Heintz's method; but this process requires such a large quantity of substance in order to effect the separation of small quantities of whatever new acid might be present, and the amount of material dwindled so in the many necessary crystallizations from alcohol to separate the dark-coloured impurities, and especially, since the determinations and reactions already made, were so confirmatory of what has lately been done in working upon the solid fatty acids, I preferred placing aside the substances thus obtained for a future examination, when the separation of fatty acids shall have become more simplified, as it must be before long.

(c) *Fossil adipocire of Bison Americanus obtained from a metacarpal bone from Big Bone Lick, by Dr. Leidy.*—It was a white powder, and in pulverizable lumps; amorphous under the microscope; with a talcose feel, and of density a little below 0·8365, since it barely swims upon alcohol of that strength, while it sinks in absolute alcohol. Water will not wet it; with the addition of hydrochloric acid and heat, it is separated without effervescence, into a mineral solution, and into an oil which solidifies on cooling to a nearly white fat, a small portion of which melted on a glass slide solidifies to a confusedly crystalline mass; a small quantity treated in the same way with absolute alcohol, crystallizes in plumose and dendritic crystals, like margaric acid. A portion of the adipocire boiled with absolute alcohol, yields but a minute quantity to the solvent, and that not of a fatty nature, showing that the fatty acid is wholly saponified with an earthy base. The whole quantity of adipocire weighed 0·986 grammes. 0·16325 heated in a platinum crucible, fuses, burning with a smoky flame and with the smell of fatty acid, but no acroleine, leaving 0·0165 or 10·1 per cent. of a perfectly white ash, which hydrochloric acid almost perfectly dissolves without effervescence, and which consists almost entirely of lime, with a few minute specks of oxide of iron (seen during the action of the hydrochloric acid,) and a couple of small grains of sand: there is a very small trace of phosphoric acid present. The greater portion of the adipocire, 0·716 grammes, was decomposed by hydrochloric acid and water, by the aid of heat: the decomposition took place with a strong smell of rancid tallow, and the fundamental smell observed in all adipocire was emitted. It was melted and washed several times, at first with acidulated and finally with pure water. The water from the washing, when evaporated, gave a certain quantity of brownish yellow colouring matter. The fat was melted in the capsule in which the precipitation took place, and weighed 0·618 or 86·31 per cent. of the adipocire; when melted, a dark flocculent humus-like precipitate was seen; the fat itself was yellowish, and of a flat, waxy (here and there warty) surface. It melted at 51°.

The adipocire therefore appears to be a lime soap of one of the fatty acids, with a trace of phosphate of lime and with flocculent organic matter, or in per centage approximatively,

Fatty acids and a little colouring matter, .	86·31
Lime and a trace of phosphate, . . .	10·10
Flocculent organic matter, . . .	3·59
	100·00

If the organic matter be neglected and the per centage then calculated, we will have,

Fatty acids, . .	89·5
Lime, . . .	10·5
	100·0

Now Stearate, Margarate and Palmitate of Lime, respectively contain a per centage of 9·3–9·7—10·2, of lime, so it is reasonable to suppose (as there is nothing in its reaction contrary, but everything favourable to this supposition) that the fossil adipocire is a neutral lime soap of the usual fatty acids of tallow.

Experiments upon the decomposition of muscular fibre (bullock's heart) with water, with a view to the formation of adipocire.

A portion of raw, and one of boiled muscular fibre from bullock's heart, were on March 8th, 1854, placed with water upon a microscope slide, and covered with thin glass, which was closed with sealing wax around the edge to prevent evaporation. This was repeatedly observed during the year, and the attention was directed at times to particular fibres the better to watch any change. At the commencement of the experiment, the cross-markings of the fibre were distinct and the fibre itself was of a delicate rose-colour. I find in my notes of April 8th, and May 11th, that no change presented itself in either the raw or in the boiled fibre, except that the cross-markings were more distinct. On December 6th, 1854, but very little change was noticed, (the raw fibre was whiter,) the cross-markings in both were more distinct than ever; by high powers an amorphous precipitate was discovered in the neighbourhood of some of the fibres—about one third of the water had evaporated.

A. On November 14th, 1853, 100 grammes of cheese were placed in a loosely stoppered bottle, and covered with distilled water, a portion of the same cheese being reserved for comparison: the water was renewed as it evaporated.

B a. On November 19th, 1853, one half of a bullock's heart, weighing 673 grammes, was placed, covered with Schuylkill water, in a wide-mouthed stoppered bottle.

B b. The remaining half of the heart, weighing 816 grammes, was covered with mineral water with lemon syrup. It was intended to use plain mineral water in this experiment, that is, Schuylkill water saturated with carbonic acid, but the former was sent by a

mistake, which was not discovered until too late. In these cases the fat was partially removed from the heart, but not to any great extent.

C. Boiled six eggs, removed the shells from two, which weighed then 88 grammes; ran pin-holes to the centre in two, which weighed 97 grammes, and left the shells upon the remaining two, which weighed 96 grammes; these were together placed in a glass-stoppered bottle, and covered with water. These different substances did not delay to decompose and give out offensive odours, and the eggs especially maintained their proverbial character in this respect; in fact, on the approach of the cholera season I was obliged to place the bottle of eggs on a plate, cover it with a large inverted beaker glass, and heap the rim of the beaker with hypochlorite of lime. With regard to the heart, the contents of the bottle containing mineral water, as might be expected, preserved their lively red colour for a longer time than in the case of the bottles containing river water.

The appearance of these bottles, on December 13th, 1854, was as follows:—

The cheese *A* was converted into a white, thick, grumous mass, lighter than water, and which when diluted with a little water, presented the appearance of pus; under the microscope with moderate power, angular transparent fragments constituted the principal part, and among these, polarized light showed many broken blade-shaped crystals without a play of colours; a few globules of oil were also seen. The material *A* was removed to a glass-stoppered bottle, more water added, and was set aside. A portion of the cheese used in this experiment had been preserved in paper; it was found hard, and on the surface oily. It was placed aside in a cork-stoppered bottle.

B. The bullock's heart had been so divided, that each half contained an auricle and ventricle, which were placed in the bottles, (*a*) with water, (*b*) with carbonic acid water. The appearance of the contents of these bottles at present is similar, though (*a*) seems to be more disintegrated. In both of these, the cavities and valves of the heart maintain, in a measure, their form, and the chordæ tendineæ are in perfect preservation: the serous covering of the heart is consistent; and in (*b*) it is, in parts, quite black from sulphuret of iron. The fluid in both bottles reacts strongly alkaline; when the mass of the heart is cut open, the muscular fibre appears of a dirty, yellowish-red colour, and when examined under the microscope, shows the fibre, but without any of the cross-markings in (*b*.) In (*a*,) which was more disintegrated, by the addition of water and a power of 700 diameters, the fibre could be seen broken in small portions, and giving evident traces of both longitudinal and cross-breaking up of the sarcous substance. The fibres of (*a*,) treated with hot and cold alcohol evinced no change; with hot acetic acid they shrunk in dimensions. The weight of (*a*) dripping with liquid was 330 grammes, that of (*b*) 275 grammes.

C. The Eggs.—The water was strongly alkaline; the shelled eggs were seen in broken,

yellowish-white lumps, and a thick deposit at the bottom of the bottle, gave no evidence of crystallization under the microscope with polarized light. The liquid from the eggs and from the two heart experiments emitted rather a disagreeable odour, which was mingled with an aldehyde smell.

As decomposition had not advanced to its full extent in these bottles, I preferred setting them aside for a future research, when both the solid and the liquid contents will be examined. Braconnot's* analysis of bullock's heart is as follows:—

Water, ...	77·03
Fibrine, cellular tissue, nerves, vessels,	17·18
Albumen and colouring matter of the blood,	2·70
Alcoholic extract and salts, . . .	1·94
Aqueous extract and salts, . . .	1·15
	100·00

ARTIFICIAL FORMATION OF ADIPOCIRE.

On December 8th, 1853, a bullock's heart weighing 1240 grammes, without removing its fat, was buried in sand in an inverted tubulated receiver held in a retort stand, and so placed against the glass that a portion of it could be seen: a reservoir of water was placed above the receiver, and this water was suffered to fall, drop by drop, upon the sand by means of a syphon of lamp-wick. The water was removed when necessary, and the changes appearing in the heart observed. These changes were the same as in the case of the bottled experiments; it began soon to deepen in colour, and on May 11th, 1854, was quite dark, while the liquid falling from the receiver contained a black amorphous precipitate, which is probably, from Liebig's observation of a similar case, sulphuret of iron. A deep zone of green vegetable parasitic matter was visible around the inside of the receiver, commencing within half of an inch above the position of the heart where it was deepest in colour, and thence diminishing as it approached the surface of the sand. On June 7th, the heart was removed and dissected for the purpose of viewing the extent of the decomposition: it maintained its original form, but was larger; the separation of the chambers was apparent; the valves present and the chordæ tendineæ in a perfect state; the greater part of the fleshy walls of the heart was pinkish, soft, of the consistence of lard, of putrid smell, and under the microscope (700 D,) presented an amorphous mass, mingled with fragments of crossed muscular fibre. It was not in as advanced a stage of decomposition as the bottled hearts of December 13th, 1854. The fat which was purposely left around the coronary vessels, was hard, white, and of an appearance approaching that of adipocire. The heart was returned to the vessel and the experiment continued. On my return to

* Ann. de Ch. & de Ph., xvii. p. 390.

the city, after an absence in the summer time, I found that the water reservoir and lamp wick had fulfilled their duty, for the sand was still moist. On December 9th, 1854, the experiment was concluded, and the heart removed from the sand and washed. It was in two pieces, and weighed, when still wet, 219 grammes: after drying in the air for five days it weighed 107 grammes, or 8·6 per cent. of the original weight, and was still moist. This was principally the fat from around the coronary vessels, the impressions of which were on it; the tendinous chords of the valves were perfect, and the valves themselves were indicated. The smell was decidedly tallowish, with the strong smell I have described as adipocire smell, and with the smell of earth worms; all of these odours were plain, and suggested themselves at once to the mind. The fat was hard, and resembled exactly adipocire; it presented a different appearance in two different places: one portion was hard and compact, in some parts denser, in others lighter than water, and appeared granular under the microscope, like the specimens of adipocire already described: the other portion was of a more buttery nature, and of about the density 0·8365. Neither of these specimens gave any traces of fat globules with the microscope, but contained aggregations of white angular fatty matter, of nearly the same size, and about one fourth the diameter of fat globules. With ether the fat disappeared, and left shrunken membranous matter, which after the evaporation of the ether and treatment with acetic acid, became, for the most part, transparent. A comparative experiment with beef fat gave similar results, and I am inclined to think that the most of this matter proceeds from the fat cells,* and their accompanying cellular tissue.

On cutting through the thickest portion of this adipocire, the fat was of a pure white colour, and could not be distinguished from adipocire; in some portions it was nearly an inch in thickness, and at first sight certainly gave the impression that the fleshy walls of the heart were converted into fat; but on closer inspection, this seemed to me improbable. The lumps of adipocire were thickest at the top of the heart, and just where were the lumps of fat in which the coronary vessels were imbedded; moreover, it was the most like adipocire in the centre of those very portions of fat. I obtained the approximate density of the adipocire of this part, by diluting alcohol with water, until the adipocire just swam half way between the surface and the bottom of the liquid, and found it to be 0·8902, which is by experiment lower than that of ox fat. Indeed, as would a priori seem probable, the fat, by the gases evolved during the putrefaction of the proteine bodies, is rendered more porous, and of a lower specific gravity, which deceives the eye, and makes the mass of fat to appear greater than it really is. An ash determination of this part of the adipocire performed upon 1·471 grammes, yielded 0·0015, equal to 0·102 per cent. of a reddish ash, containing iron. No acroleine was observed during this experiment, and no other

* See Kolliker, Mic. Anat., II. 1st Part, page 16.

than the characteristic adipocire smell, which proves the absence of glycerine, and that the fatty acids are uncombined. Ox fat (2·069) gave (0·001, or) a per centage of 0·048 white ash. The iron of the former proceeds probably from the hæmatine in the heart. These ashes are too small in quantity, to arrive at any satisfactory result in ascertaining the nature of their component parts; they appeared by a few tests to contain principally lime, and soda and potash were detected by Smith's test. The melting point of the above portion of adipocire was about 47°, but at 52° the fat still contained a faint precipitate.

The adipocire, on February 3d, 1855, until which time it had been kept in a loosely stoppered bottle, weighed 97 grammes, which is 7·8 per cent. of the original heart. From 91 grammes the fat was separated by boiling it with 317 alcohol, filtering hot, pressing powerfully, and weighing the residue; the latter was bulky, and weighed 40·1, corresponding to 44 per cent. of the *adipocire*, which contains, consequently, only 66 per cent. of fat. If the per centage of fat be calculated from the original weight of the *heart*, it amounts to only 4·4, which is undoubtedly less than was originally in the heart, so that, so far from there being a gain of fat in the formation of the adipocire, there was actually a loss, which accords with the bottle experiments. The alcoholic solution deposited 16·2 grammes of a rather dark fat, which was re-crystallized from 368 grammes of alcohol, and yielded 11 grammes of a lighter fat. I was desirous of retaining a greater portion of this fat for future experiments, and without proceeding to purify it further, obtained its equivalent. It melted between 69°—70°, did not crystallize plainly from alcohol, with which it behaved like stearic acid: a neutral silver salt, deepened in colour considerably when dried at 100°, and gave only 20·59 and 20·68 per cent. of silver. As decomposition had evidently taken place in this salt, the baryta compound was prepared by adding acetate of baryta to the alcoholic solution. The baryta was determined both as carbonate and by converting into sulphate; there was no difference in the two results; the baryta of the carbonate was 0·1701, and that of the sulphate was 0·1700, which corresponds to a per centage of 19·65—stearic acid (Heintz) requires 21·76 per cent., and palmitic acid 23·62 per cent. of baryta for the neutral salts. I have no doubt that a further purification will show this to be stearic acid, as might be expected from the original fat of the heart.

I am not desirous of claiming for these experiments a greater importance than they deserve, nor any but that the experiments were carefully performed: they were extended over the greater part of a year, during which my attention has been particularly directed to this subject. When the investigation was commenced, I was inclined to the belief that adipocire was a result of the decomposition of the blood-forming substances, and this, principally, from the experiments of Blondeau (see first part of this article) which I have not seen refuted, and partly from the testimony of those who have had opportunities of observing the formation of adipocire, and who have stated that fleshy parts of the body

are wholly converted into it. The formation of the lower terms of the series of fatty acids from proteine bodies forbids maintaining that this is impossible; but from what I have seen, and on weighing the evidence of what I have read, my impression is, that adipocire proceeds from the original fat of the body.

It appears to follow from the foregoing experiments, that the higher members of the series of fatty acids do not result from the putrefaction of proteine compounds; at least from such putrefaction as is accompanied by exclusion of air. Flesh fibrine with restriction of air does not putrefy as rapidly as would be supposed, according to the experiment, where a portion was sealed with water on a microscope slide; the air here was not absolutely excluded, since a partial evaporation of the water took place. It is true that the amount of water in this experiment was small, in proportion to the fibrine, and it appears that much water is necessary to such decomposition, and which supports Liebig's theory of the motion of the molecules. In the experiments of the bottles and of the sand, the decomposition was *seen to take place* gradually; the sarcous element of the flesh fibrine separated into discs, and these were by degrees resolved into their simpler compounds, which either remained as liquids or gases in solution in the bottles, or were carried off by the droppings in the sand experiment. The original fat of the body, according to circumstances, either partakes of this decomposition, or else, losing its glycerine and most of its oleic acid, becomes gradually converted into adipocire. In some bodies in the grave yards the fat is totally gone, while in others large quantities of adipocire are formed. It is suggestive that in all cases where adipocire has been found, the corpse was of a large and fat person, and this abundance of fat resists an ultimate decomposition. Analyses by Beetz of candles which had remained for a hundred years in a mine, prove that the only alteration undergone by fats when alone, is destruction of their oleine and glycerine. In the bottles of my experiments no adipocire was formed, although the fat of the coronary vessels was only partially removed; this may be accounted for on the ground that the fat, which was small in quantity, was here kept in close contact with the decomposing fibrine, and suffered with it decomposition, whereas in the sand experiment, this could only take place to a less degree. In grave yards, if the proportion of flesh to fat be large, and especially if the ground be of such a nature as to prevent the decomposed matter being carried off, as by draining, adipocire cannot be formed, but the fat undergoes full decomposition.

The fact that in adipocire from different animals, the same substances are found accompanying the original fat of the animal, as the goat-like or mutton smell in sheep, and the tallow smell of the fossil adipocire, is suggestive, and should shift the burden of experimental proof upon those who maintain the formation of this substance from fibrine. The microscopic experiments militate against the transformation from fibrine. Those that believe in this change think to have proof from the shape, as it were, of certain muscles

transformed into fat; but fibrine does not require to lose much substance in the shape of ammonia, &c., for this transformation, and there would not be, therefore, a great disturbance in the shape of the fibres of muscle; at any rate, it would be reasonable to expect, that with the microscope, traces of an arrangement of the fatty particles into fibres or rows would here and there be seen, but this is not the case, and the appearance is that of fat particles of equal size among themselves, and of a diameter one-fourth that of the original fat globules, and indeed presenting all the appearances to be expected from a mass of fat undergoing alteration from the decomposition of its oleine and glycerine; and finally in the experiment where adipocire was artificially formed, no gain of fat was observed, but a loss of what was purposely left upon the specimen under examination.

I shall delay an examination of the products in my hands, until the separation of the fatty acids is improved. It would be easy enough with the present methods to isolate the two principal constituents of the fatty acids from the material in hand; but small quantities of new products would inevitably escape observation.

The *desiderata* in working the fatty acids at present, are, First, separation of the oleic acid, without too much loss of substance.

Second, a less circuitous method of separating the fatty acids than by Heintz's method, which renders difficult the isolation of small quantities of a different acid, as shown by his mistake of anthropic acid.

It is probable that a crystallization of salts (especially with a base of a high equivalent) would effect this purpose, for in crystallization, other compounds and impurities are concentrated in the mother liquids, while in fractional precipitation, in the present case, an infinite subdivision seems to take place, requiring many steps to accomplish a sufficient purification; and brilliant as Heintz's results are, considerable labour was required to arrive at them. Heintz's process of partial precipitation was founded upon the method of fractional distillation, proposed by Liebig for the separation of the lower members of the series of fatty acids; in the latter case presence of an alkaline carbonate, in quantity insufficient to saturate the mixed acids, alters their volatility, while in the former, presence of a salt in insufficient quantity for perfect decomposition changes the relations of *solubility* of the salt formed, and it does not necessarily follow that the chemical affinity, active in both cases, will afford as *expeditious* a method in cases of solubility as in those of volatility.

ARTICLE II.

REVISION OF THE CICINDELÆ OF THE UNITED STATES.

BY JOHN L. LE CONTE, M. D.

(Read, February 1st, 1856.)

The genus Cicindela, a favourite with all entomologists, contains a very large number of species which are mostly distinguished by brilliant colours, and conspicuous markings. Although easily recognised by direct comparison, the structure of these numerous species is varied upon such uniform types, that much difficulty is found in identifying an unknown one by description, and the descriptions given by authors are frequently either obscure from their brevity, or tedious from their length. This necessarily results from the want of success in dividing the genus into small groups defined by easily recognised characters; and it is much to be regretted that some of the entomologists of Europe, with large collections at hand, have not made an effort to produce a monograph of this beautiful genus.

The species found in the United States have been increased since the publication of Say's monograph, in the first volume of this work, from 13 to 65; the descriptions of these have become so scattered as to be rather troublesome to the student, and as I have fortunately obtained specimens of all those previously described, excepting three made known by Say after the publication of the monograph mentioned, it appeared to me to be a work not altogether without profit to science, to attempt to bring together such notes upon these species as would enable subsequent investigations to be carried on with less labour than has been previously required.

Before proceeding to the description of the species, I have attempted to group them in such manner as to divide the characters common to several, from those which are peculiar and diagnostic, and I have presented the result in a synoptic table. In making

these comparisons I have availed myself of the copious collection of foreign species belonging to the Academy of Natural Sciences, and but recently presented to that institution by Mr. John A. Guex. As many groups of foreign species are not represented in our fauna, I have indicated such as could be conveniently placed in the table following; these are marked by brackets, and I have also occasionally added the name of a foreign species, also within brackets, where the American representatives of the group were not likely to be extensively known. The table thus has assumed the form of a general, but very imperfect, arrangement of the contents of the genus.

While examining the foreign species, my attention was directed to the impossibility of reconciling the system of marking of the East Indian *C. 4-lineata Fabr.* with that seen in any of the groups of genuine Cicindelæ; but on closer inspection I found that accompanying the two yellow stripes on each elytron, was a remarkable character that seems to have escaped previous observers. It is the presence of a longitudinal dorsal suture each side of the thorax: the pronotum, or tergum, is in fact narrowed, while the mass of the prothorax is subjected to no diminution; the lateral sutures separating the pronotum from the lateral pieces of the prothorax, which in all other species are seen on the under surface, in this instance become dorsal. This peculiarity seems to necessitate the formation of a new genus, for which the name *Hypætha* may be adopted.

The system of colouration is called normal in the following pages when the under surface and legs are of a more or less metallic colour; the abnormal variations are few, and consist in the abdomen being red, or the legs in part or in whole pale or red, without metallic lustre.

The spots of the elytra are normal, when they are of the following type, more or less reduced by deficiency; a humeral narrow curved spot, called lunule; a middle band more or less bent, and descending internally; and an apical curved line usually bent inwards at its anterior part: these spots are sometimes confluent on the margin, and sometimes separate: they are sometimes entire, and sometimes interrupted, and occasionally reduced to merely marginal spots.

Abnormal variations occur; 1, by additional spots at the base or near the suture (groups XI., XII., XIII.;) 2, by the deficiency of the terminal part of the apical lunule, while its anterior part is well marked, (groups II., III., XVII.;) 3, by the inner portion of the middle band being lost, while the external marks become confluent, forming a broad white margin, only slightly lobed internally (groups XX., XXI., XXII.:) 4, by the marks being removed more or less from the margin of the elytron (group X.; and still more in XXIII.)

The form is called normal when the humeral angles are distinct, and the elytra moderately convex and oval, when the head and eyes are moderately large, but not excessive, and when the thorax is quadrate, trapezoidal, or subcylindrical, with well-marked impres-

sions. Abnormal variations occur by the elytra becoming narrowed anteriorly, without humeral angles, (group XXIV.;) by the thorax being narrow and cylindrical, with only faint impressions (group XXIV.;) by the eyes being excessively large, (groups XI., XII., XIII., XIX., XXI., XXII., XXIV.;) and by the elytra being subcylindrical, instead of moderately convex and oval, (groups XII., XXI., XXII., XXIII.)

A. Abnormal cylindrical Cicindelæ, with sericeous surface, and with the labrum variegated or black, frequently 5-toothed, with prominent exterior angles; the elytra are marked with narrow vittæ, and small sutural dots, or else with normal spots, the apical portion of the apical lunule being always wanting. The head is large, with moderate, but occasionally prominent eyes. The palpi are pale with dark tips. The legs and abdomen are always of the colour of the body, which is not very pubescent. The tarsi are glabrous above, and the anterior of the male are moderately dilated. (All foreign.)

a. Elytra with vittiform markings, and subsutural dots. C. lugubris, fatidica, &c.

b. Elytra with marginal spots, and frequently with slightly bent medial band. C. chinensis, &c.

B. Normal, frequently flattened, Cicindelæ, with the labrum frequently large; sub-5-dentate in some species, (of the first group,) with the outer angles not prominent; usually white, rarely black, usually tridentate, but sometimes only unidentate. Front broad, eyes moderate, sometimes prominent. Elytra usually sericeous, rarely polished, sometimes punctured; apical spot usually wanting; tips never serrate; sutural spine completely wanting. Thorax flattened, almost margined, narrowed behind. Under surface normal in colour; legs never very long. Tarsi of male more broadly dilated than usual.

I. Surface sericeous, elytra only punctured towards the base, (spots usually wanting.) Sp. 1–3. C. prasina, obsoleta, vulturina.

II. Front flat, labrum tridentate. Elytra foveate and punctured. Sp. 4. C. unipunctata.

III. Front excavated, labrum unidentate. Elytra foveate and punctured. Sp. 5. C. longilabris.

IV. Labrum very short, tridentate; elytra with shallow punctures and subsutural foveæ; thorax hardly rugous. Sp. 6–10. C. pulchra, Lecontei, rugifrons, scutellaris, nigrocœrulea.

(Here comes in a group of elongate species of normal form, but with very large head, small eyes, and long, trapezoidal, somewhat flattened thorax: *e. g.*, C. luctuosa *Dej.*)

C. Normal, usually convex Cicindelæ, with the labrum white, tridentate or unidentate, with the outer angles not prominent, and only moderate in size. Front broad, eyes prominent, but moderate in size. Elytra punctured, sometimes granulate, rarely polished; sutural spine distinct; tips alike in both sexes, usually serrate, but sometimes smooth; elytra with normal markings, the apical portion of the posterior lunule never wanting, unless the whole lunule is wanting. Under surface and legs normal in colour, the latter never very long. Tarsi of males rather broadly dilated. Thorax trapezoidal or quadrate, never cylindrical; posterior angles usually a little elevated.

V. Thorax convex, rugous; front glabrous; elytra finely serrulate, punctured. Body only slightly hairy beneath. Palpi of both sexes black.

α. Labrum tridentate. Sp. 11, 12. C. sexguttata, patruela.

{β. Labrum unidentate. C. tricolor.}

VI. Thorax short, flat, trapezoidal, rugous; front hairy; elytra with elevated punctures, not serrate; humeral lunule interrupted; palpi of both sexes black.

{γ. Elytra equably punctured. C. campestris, desertorum, &c.}

δ. Elytra less punctured towards the margin. Sp. 13, 14. C. splendida, purpurea.

Thorax rugous and granulate, usually convex; elytra punctured obsoletely serrate; humeral lunule prolonged.

{Front glabrous. C. distans, Zwickii.}

VII. Front, thorax and body very hairy. Sp. 15–21. C. Ancocisconenis, venusta, generosa, formosa, latesignata, vulgaris, fulgida.

VIII. Thorax rugous and granulate, usually short or quadrate, flattened; elytra punctured, with elevated granules intermixed, distinctly serrate. Sp. 22–26. C. oregona, guttifera, 12-guttata, baltimorensis, hirticollis.

IX. Thorax sub-cylindrical, hardly granulate, finely rugous; elytra punctured, serrate. Sp. 27. C. tenuisignata, {dignoscenda.}

X. Head and thorax finely granulate, the former with curved striæ on the vertex; elytra punctured, not serrate, marks remote from the margin. Sp. 28–31. C. imperfecta, pusilla, circumcincta, cyanella.

D. An entirely anomalous group, with large prominent eyes; the thorax is quadrate or sub-cylindrical, (wider posteriorly in some females;) the posterior impression is deeper externally, but does not reach the sides of the thorax; posterior angles elevated, sometimes prolonged; elytra sometimes white, usually with white basal spots, (except in C. sperata;) legs very long, with the claws larger than usual; body beneath normal in colour; trochanters in many of the native species red.

{α. Front slightly pubescent; thorax with posterior angles prolonged. C. capensis.}

XI. β. Front glabrous, elytra white, trochanters purple.

{Right mandible of male not toothed inferiorly. C. nivea.}

Right mandible of male with an inferior tooth near the tip. Sp. 32–34. C. dorsalis, media, Saulcyi.

XII. γ. Front pubescent, (body cylindrical,) trochanters red.

Right mandible of male with inferior tooth. Sp. 35, 36. C. lacerata and marginata.

Right mandible of male not toothed inferiorly. Sp. 37–40. C. cuprascens, blanda, macra, sperata.

{δ. Front with a few hairs behind the eyes, trochanters purple. C. Candei, &c.}

XIII. E. A broad, flattened species, having the elytra white, even to the suture; head densely pubescent; eyes very large; thorax cylindrical; legs pale. Sp. 41. C. lepida.

F. Species of regular form and normal colouring, with the head and thorax finely granulate, the elytra punctured, with a subsutural row of foveæ, finely serrate; thorax sub-cylindrical, narrowed behind; labrum unidentate.

XIV. Middle band tortuous. Sp. 42–45. C. ascendens, serpens, sigmoidea, tortuosa.

XV. Middle band interrupted, (rectangularly bent.) Sp. 46. C. punctulata.

XVI. Spots wanting; head and thorax hardly granulate. Sp. 47. C. corvina.

G. Species of regular form, with sericeous surface; thorax quadrate or sub-cylindrical, not rugous or granulate; eyes moderate or large, but never excessive in size; elytra serrate.

XVII. Apical part of terminal lunule wanting. Sp. 48. C. decostigma.

XVIII. Terminal lunule complete, abdomen red. Sp. 49–53. C. hemorrhagica, Hentzii, 16-punctata, rufiventris, cumatilis.

XIX. H. A small black species with red abdomen, and edentate rounded labrum; eyes very large. Sp. 54. C. abdominalis.

XX. I. An elongate species of obscure colour, with moderate eyes; thorax cylindrical; elytra not serrate margined with white; abdomen with the sides and tip red. Sp. 55. C. marginipennis.

K Cylindrical species with the eyes very large; the elytra punctured and finely serrate; legs and abdomen normal in colour; anus usually pale.

XXI. Abdomen glabrous in the middle.

α. Head strongly striate, glabrous; elytral spots marginal. Sp. 56. C. severa.

β. Head finely striate, glabrous; elytra with white margin. Sp. 57, 58. C. circumpicta, prætextata, {Ruppellii, boops, and biramosa.}

γ. Head pubescent; elytra with very broad white margin. Sp. 59. C. togata.

XXII. Abdomen entirely pubescent. Sp. 60. C. gratiosa.

XXIII. L. A cylindrical species with red legs and strongly punctured elytra, marked with a discoidal vitta. Sp. 61. C. lemniscata.

M. Small species having the eyes very large, the thorax cylindrical and elongate, and the elytra narrowed in front, without humeral angles; wings imperfect.

{α. Elytra glabrous. C. dromicoides.}

XXIV. β. Elytra sparsely pubescent. Sp. 62, 63. C. celeripes, cursitans.

GROUP I.

This group contains species of an elongate not convex form, and dull sericeous black or green colour. The labrum is moderately large, with five anterior teeth, in the males the exterior one of these teeth each side is reduced to a slight sinuosity so that the labrum appears tridentate; the lateral angles are rounded. The palpi of the female are usually entirely black; the labial palpi of the male are pale, with the last joint black. The front is rather flat, glabrous, with only a few very fine striæ each side. The thorax is trapezoidal, not very convex, with the transverse impressions well defined. The elytra are slightly convex, indistinctly punctured except at the base, where the punctures are large and scattered: the apex is not serrate, broadly and conjointly rounded in both sexes, sutural spine very small: the usual white spots are very small or entirely wanting; the pattern, when most complete, is a humeral spot, an obtusely bent medial band, and an apical lunule. The legs, under part of the thorax, pleuræ, and sides of the abdomen are clothed not densely with white hair; a few hairs are also seen above on each side of the thorax. The three joints of the anterior tarsi of the male are equal in width, and moderately dilated.

1. C. prasina, obscure nigro-prasina, sericea, thorace trapezoideo, latitudine sesqui breviore, planiusculo, lateribus parum rotundatis parce pilosis, angulis posticis rotundatis prominulis, subtus nigro-viridis, thoracis pleuris abdominisque lateribus modice albo-pilosis; labro albo, breviusculo, antice haud rotundato, breviter tridentato. Long. ·77.

C. obsoleta ‡ var. Lec. Ann. Lyc. Nat. Hist. 4,178.

One male found by me on the Arkansas River below Bent's Fort. Closely allied to the next, and not differing in sculpture; the form of the thorax is however so different, that it cannot be considered as a variety: the posterior angles are in the same manner rounded, and separated from the base by a slight margin, which causes them to appear prominent: the labrum is shorter, and the elytra wider than in C. obsoleta.

2. C. obsoleta, nigra, sericea, thorace subquadrato, latitudine vix breviore, planiusculo, lateribus fere rectis parce pilosis, angulis posticis rotundatis prominulis, subtus nigra, lateribus albo-pilosis; elytris puncto albo marginali sæpius obsoleto ad medium notatis; labro albo, antice subrotundato, 5-dentato, (dentibus externis maris fere obsoletis.) Long. ·68—·80.

Say, Journ. Acad. Nat. Sc. 3143. Lec. Ann. Lyc. Nat. Hist. 4,178, tab. 13, fig. 4.

Abundant on the arid table lands east of the Rocky Mountains, about the upper parts of the Platte and Arkansas Rivers. Flight active and vigorous.

3. C. vulturina, nigra, sericea, thorace trapezoideo, latitudine vix breviore, paulo convexo, lateribus modice rotundatis parce pilosis, angulis posticis haud prominulis; elytris gutta humerali, fascia angusta obtuse angulata ad medium lunulaque apicali albis, sæpe obsoletis; subtus cyanea lateribus albo-pilosis; labro antice infuscato rotundato, (feminæ) sub-5-dentato. Long. ·61—·67.

Lec. Proc. Acad. Nat. Sc. 6, 439.

Eagle Pass, Rio Grande, Texas: collected by Mr. Schott of the Boundary Commission. Nearly related to the preceding, but the thorax is more convex, and more rounded on the sides, and the posterior angles fall into the base instead of being prominent. The middle band of the elytra is about as sinuous as in the well known C. limbalis, (a race of C. splendida) but is narrower and frequently obsolete.

GROUP II.

The group contains one species of a somewhat flattened form, and dull brownish colour, above almost without metallic reflections. The labrum is large, prominent in the middle, with three distinct teeth; the outer angles are very obtuse. The palpi of both sexes are entirely black. The front is flattened, finely wrinkled, and striate towards the eyes, entirely bald; the surface of the head and thorax is distinctly granulate. Thorax flattened, trapezoidal. Elytra not serrate at tips, which are separately acutely rounded, without any sutural spine: the punctures are large and shallow, the markings marginal, frequently wanting. Body beneath glabrous. Eyes rather small, but prominent.

4. C. unipunctata, æneo-fusca, opaca, sericea, labro albo tridentato, fronte tota striolata, thorace trapezoideo planiusculo, latitudine haud breviore, confertim rugoso ad latera vix rotundata parce albo-piloso; elytris pone humeros latioribus, distinctius marginatis planiusculis, æqualiter punctatis foveisque sparsis præcipue versus suturam notatis, punctis omnibus cyaneis, apice singulatim rotundatis, macula marginali intus obsolete prolongata ad medium alba; subtus nigro-purpurea glabra. Long ·58—·68.

Fabr. Ent. Syst. 1,174; Syst. El. 1,238. Oliv. 33, No. 22; tab. 3,27. Herbst, Käfer, 10, 190; tab. 173, 1: Say, Trans. Am. Phil. Soc. 1, 412; tab. 13, fig. 3.

Pennsylvania, Missouri, Georgia; found in paths in shady, hilly woods in May or June, according to the latitude of the locality: the merit of discovering a locality in the immediate neighbourhood of Philadelphia is due to Mr. Schafhirt. Varieties are mentioned by Mr. Say in which there is a supplemental spot half way between the medial one and

the apex; such have not occurred to me; immaculate varieties are mentioned, but they are only greasy specimens, in which vestiges of the spot can always be traced.

GROUP III.

Species having the upper surface sericeous, the body rather flattened, and the thorax trapezoidal, usually short, and almost margined. The head is glabrous, the vertex is broadly excavated, the front is suddenly declivous anteriorly, and finely striate. The labrum is large, prominent, sometimes black (in foreign species,) and one-toothed. The markings of the elytra are variable, but the terminal part of the apical lunule is always wanting, the apex is not serrate and but slightly separately rounded. The palpi are black in both sexes: the second and third joints of the anterior tarsi of the male are slightly oblique. The body is hairy beneath on the sides; in other respects this group agrees with the preceding.

The species, which with one exception are foreign, may be divided as follows:

Labrum black, carinated, elytra punctured and foveate. C. fasciato-punctata, &c.
Labrum white, subcarinate.
Black, elytra more densely punctured, hardly margined. C. longilabris.
Green, elytra flattened, margined. C. ismenia, rotundicollis.

5. C. longilabris, purpureo-nigra, supra æneo tincta, labro albo magno, antice rotundato, obtuse dentato, lateribus sinuato, thorace latitudine fere duplo breviore, trapezoideo, confertim rugoso, impressionibus profundis, elytris confertim minus profunde punctatis versus suturam vage seriatim foveatis, gutta humerali, altera ad quadrantem, fascia media sinuata obtuse deflexa, guttaque ad dodrantem albis; subtus cyanea, lateribus parce albo-pilosis. Long. ·55—·64.

Variat elytrorum maculis plus minusve deficientibus.

α. Supra, nigra immaculata, (thorace postice minus angustato.)

Say, Long's Expedition to St. Peter's River, 2, 268. Lec. Ann. Lyc. Nat. Hist. 4, 178.

C. albilabris Kirby, Fauna Bor. Am. 4, 12; tab. 1, fig. 1.

New Hampshire, Canada, Mackinaw, Lake Superior; inhabits paths through grassy and bushy places, and takes refuge in the herbage when disturbed. The form (α) is a female from the North shore of Lake Superior, of a pure black colour above, and broader form than usual; the thorax is less narrowed posteriorly.

GROUP IV.

Robust species with convex elytra and thorax, the latter (not much wider than its length, rounded on the sides, hardly rugose, not granulate; front deeply striate sparsely setose, or sparsely finely striate and glabrous. Labrum short, 3-toothed. Palpi of both sexes entirely black. Elytra indistinctly punctured, with a row of small shallow foveæ near the suture, conjointly broadly rounded at tip, not serrate, spots always marginal, usually small and disconnected, (except in some varieties of C. Lecontei,) and frequently

wanting. Pectus and legs sparsely clothed with white erect hairs: outer side of middle tibiæ densely pubescent. Tarsi of male moderately broad.

Species of sandy and bushy places, of active and vigorous flight, appearing only when the sun is shining.

C. pulchra seems related to C. severa, but that species is elongate and has the base of the palpi pale: the tips of the elytra are in it finely serrate and somewhat obliquely narrowed, the body is much more hairy beneath; and finally the middle tooth of the mandibles is smaller than the others, while in C. pulchra as in the others of this group they are nearly equal in size.

The species, which so far as known to me are North American, may be divided as follows.

Front hairy, elytra polished, margin of a different colour. Sp. 6.
Front hairy, elytra not polished. Sp. 7–9.
Front glabrous, finely striate each side; elytra not polished. Sp. 10.

6. C. pulchra, capite purpureo cupreoque variegato, fronte punctata pilosa utrinque parce striata, thorace convexo cupreo lævigato, marginibus omnibus cyaneis, elytris cupreis politis antice punctatis, sutura margineque cyaneis, gutta humerali, alteraque submarginali ad medium albis, sæpe deficientibus; subtus cyanea, vel viridis, lateribus longe albo-pilosis. Long. ·73.

Say, Journ. Acad. Nat. Sc. 3, 142: Dej. Sp. Gen. 2, 421: Lec. Ann. Lyc. Nat. Hist. 4, 175: tab. 13, fig. 1.

Found on the arid table lands adjacent to the Rocky Mountains from the Platte River to the Rio Grande. A species of strong and vigorous flight, not common and very difficult to capture.

7. C. Lecontei, supra cupreo-purpurea, haud nitida, fronte fortiter striata parce punctata et pilosa, thorace convexo, vage at distincte rugoso, elytris brevibus convexis obsolete punctatis versus suturam seriatim vage foveatis, maculis marginalibus sæpe cohærentibus albis, subtus obscure cyanea ad latera pilosa; labro sexus utriusque albo tridentato. Long. ·5.

Haldeman, Proceedings of the Academy of Nat. Sc. of Philad. 6, 361.

Wisconsin, near Green Bay, Mr. Guex: near Racine, Messrs. Hoy and Barry; Fort Gratiot, Dr. Kirtland. Very closely allied to the next, and not differing in form, in any respect: the labrum is however white in both sexes, and the thorax is sparsely but distinctly rugous. The humeral lunule is frequently entire, the medial spot is triangular and large, very often connected with the humeral and apical lunules: the latter recedes anteriorly from the margin, and is prolonged forwards. Sometimes the humeral lunule is reduced to a post humeral marginal dot. Varieties will doubtless occur in which the spots are small, or even entirely wanting.

8. C. rugifrons, cyaneo-viridis vel nigra, fronte fortiter striata parce punctata et pilosa, thorace convexo, haud vel vix rugoso, elytris brevibus convexis obsolete punctatis, versus suturam seriatim obsolete foveatis, gutta posthumerali, macula triangulari media, lunulaque apicali sæpe cohærentibus, sæpe autem deficientibus albis; subtus ad latera pilosa; labro tridentato maris albo, feminæ nigro-piceo. Long. ·43—·5.

Dej. Sp. Gen. 1, 51; 5, 209: Gould, Bost. Journ. Nat. Hist. 1, 46.

C. denticulata Hentz, Trans. Am. Phil. Soc. 3, 254, tab. 2, fig. 1: Harris, New Engl. Farmer, 7, 90.

C. obscura || Say, Trans. Am. Phil. Soc. 1, 418, (nec Fabr.) (gens nigra.)

C. modesta Dej. Sp. Gen. 1, 52: Lec. Ann. Lyc. Nat. Hist. 4, 175, (gens nigra.)

α. Elytris brevioribus et paulo convexioribus, præcipue immaculatis, vel lunula apicali obsoleta notatis.

C. unicolor Dej. Sp. Gen. 1, 52: 5, 210.

Found in sandy places, in various parts of the Eastern, Middle and Southern States. The black race does not occur at the same localities with the green one, but on close comparison, nothing of specific character can be found to separate them. The form α is found in Georgia, Alabama and Florida, and is usually of a more obscure green than the type.

9. C. scutellaris, viridi-cyanea, capite thoraceque haud nitidis, fronte fortiter striata, parce punctata et pilosa, thorace convexo, confertim subtiliter rugoso, elytris flavescente-cupreis versus scutellum virescentibus, haud nitidis, brevibus convexis obsolete punctatis, versus suturam obsolete foveatis, puncto marginali ad medium lunulaque apicali sæpissime deficientibus albis: subtus ad latera pilosa; labro tridentato, maris albo, feminæ piceo. Long. ·45.

Say, Journ. Acad. Nat. Sc. 3, 140: Lec. Ann. Lyc. Nat. Hist. 4, 176; tab. 13, fig. 2.

Valley of Platte River, on sand hills in June; not abundant. The colour of the head and thorax varies from full green to blue: the sides of the latter are less rounded in the male than in the female. The colour of the elytra also varies from coppery to brassy.

10. C. nigrocœrulea, nigro-purpurascens, sericeo-micans, fronte glabra subtiliter rugosa, utrinque striata, thorace modice convexo, latitudine breviore, parce rugoso ad latera pilis parcis depressis albis, elytris minus convexis obsolete punctatis, versus suturam seriatim foveis cyaneis impressis, lunula apicali obsoleta alba; subtus ad latera parce haud erecte albo-pilosa; labro sexus utriusque albo, maris obsolete, feminæ distincte tridentato; palpis labialibus maris basi pallidis. Long. ·5—·57.

Leconte, Annals of the Lyc. of Nat. Hist. of New York, 4, 181, tab. 14, fig. 9.

One pair found near Bent's Fort on the Arkansas River. The elytra of this species are more elongated than in the others of this group, and the sexual characters are different; yet by the indistinct punctures of the elytra, as well as by the absence of serrature and sutural spine, it seems to be here properly appended. It is a stouter species than C. punctulata, which it at first sight seems to resemble.

GROUP V.

Labrum moderate, advanced in the middle, strongly tridentate. Head and thorax glabrous, finely rugose, the former finely striate between the eyes, the latter convex and strongly impressed. Palpi entirely black. Elytra strongly punctured, broadly rounded, and but very obsoletely serrate at tip, sutural spine distinct: spots small, the anterior ones in one species hardly ever visible. Body beneath very sparsely pilose.

Differs from the next group by the bald front, and slightly serrate tips of the elytra.

11. C. 6-guttata, viridis, vel cyanea haud nitida, fronte striata glabra, postice rugosa, thorace latitudine breviore, convexo postice angustato, minus subtiliter rugoso, elytris valde punctatis, gutta ad medium (sæpe intus paulo oblique prolongata) lunulaque apicali interrupta albis, maculis his sæpe deficientibus; subtus vix parce albo-pilosa; labro sexus utriusque albo, medio paulo porrecto, fortiter tridentato. Long. ·4—·53.

Fabr. Ent. Syst. 1, 176; Syst. El. 1, 241: Oliv. 33, No. 27; tab. 2, 21: Herbst, Archiv. tab. 27, 17; Käfer, 10, 171, tab. 171, 6: Say, Trans. Am. Phil. Soc. 1, 414; table 13, fig. 4: Dej. Sp. Gen. 1, 53: Gould, Boston Journ. Nat. Hist. 1, 45.

VAR. *C. violacea* Fabr. Syst. El. 1, 232: Herbst, 10, 198.

Newfoundland, Pennsylvania, Louisiana, Wisconsin, and Nebraska. Lives usually in roads running through shady places, and is easily captured. Exhales a fragrant odour. Nearly related to the Siberian C. cœrulea.

12. C. patruela, viridis, olivaceo-brunnea, vel cyaneo-nigra, haud nitida, fronte subtilius striata glabra, capite postice rugoso, thorace latitudine breviore convexo, postice angustato, dense rugoso, elytris punctatis, subgranulatis, lunula humerali apicalique interruptis, fascia media obliqua vix sinuata albis; subtus lateribus parce albo-pilosis; labro sexus utriusque albo, medio paulo porrecto, tridentato. Long. ·5—·58.

Dej. Sp. Gen. 1, 62: Gould, Bost. Journ. Nat. Hist. 1, 44; tab. 3, fig. 4: Lec. Ann. Lyc. Nat. Hist. 4, 178.

C. consentanea Dej. Sp. Gen. 1, 63. (var. obscurior.)

Middle States, in shady paths on hills. The middle band consists of a large lateral triangular spot connected with a small discoidal one, by a slightly oblique narrow line.

GROUP VI.

This group contains closely allied, and in fact undistinguishable species, having the labrum moderate, slightly advanced and 3-dentate in the middle: palpi black in both sexes: eyes moderate, not prominent: head and thorax granulate and rugose, the front striate and pilose with erect hair; the latter not very convex, obliquely narrowed behind, with the impressions very deep. Elytra moderately punctured, punctures almost always elevated, broadly rounded and not serrate at the tips; spots always disconnected, anterior ones frequently wanting; under surface with long white hair, which is sparse on the abdomen, but more dense on the breast. Legs not elongated, hairy; tarsi of the male with moderately dilated joints.

The foreign species of this group (C. campestris &c.) have the elytra equably punctured, while in ours the punctures near the lateral margin are less distinct.

13. C. splendida, supra varicolor, thorace marginibus viridibus, capite discoque sæpius cupreis valde rugosis, elytris elevato-punctatis sutura sæpissime viridi, puncto humerali, altera posthumerali sæpe deficiente, fascia sinuata perpendiculariter oriente, gutta anteapicali, lunulaque terminali albis, margine late viridi vel cyaneo, minus distincte punctato. Long. ·4—·56.

α. Brevior, supra purpurea, thorace lateribus magis rotundatis, elytris antrorsum paulo angustatis, convexioribus, fascia media completa, guttis marginalibus sæpe obsoletis; subtus cyanea.

C. limbalis var. Lec. Ann. Lyc. Nat. Hist. 4, 177.

β. Longior, præcipue cuprea, thorace lateribus parum rotundatis, elytris planioribus antrorsum haud angustatis maculis completis.

a. Nigra. *C. spreta* Lec. Ann. Lyc. 4, 177; tab. 13, fig. 7.

b. Cuprea. (♂ ♀) *C. limbalis* Klug. Jahrb. Ent. 1, 29. *C. marginalis* var. Dej. Sp. Gen. 5, 210.

c. Cuprea, fascia media introrsum attenuata, puncto humerali deficiente.(♀)

d. Cuprea, fascia media extrorsum subobliqua.(♀)

e. Læte cuprea, fascia media minus subito sinuata.(♀) *C. amœna* Lec. Ann. Lyc. 4, 177; tab. 13, f. 3.

f. Capite thoraceque totis viridibus.(♂)

g. Cuprea, elytris fascia media intus abbreviata, guttis marginalibus minutis.

γ. Latior, præcipue læte cuprea, capite thoraceque viridibus, elytris planioribus guttis marginalibus nullis, fascia, media intus valde abbreviata, lunula apicali parva.

a. Capite thorace elytrisque margine latiore viridibus. *C. splendida* Hentz, Trans. Am. Phil. Soc. 3, 254; tab. 2, fig. 3: Lec. Ann. Lyc. Nat. Hist. 4, 176. *C. sexguttata* var. Fabr. Syst. El. 1, 241.

b. Capitis thoracisque disco cupreo. (♀) *C. splendida* var. Klug, Jahrb. 1, 23.

c. Purpureo-cyanea, elytrorum disco obscure viridi.(♀)

Extensively diffused, yet not with the races intermingled: the localities of the specimens observed are as follows: α. New York and New Jersey, on wooded hills: β—a. Eastport, Maine, Dr. Harris: β—b. Rockport, Ohio, and Fort Gratiot, Dr. Kirtland, also in Missouri, Dr. Hoy; β—γ. New York; γ—a and b. Southern and Western states; γ—c. Arkansas, Dr. Schaum. Very closely allied to the next, and in fact the only difference that can be perceived is the direction of the origin of the middle band which is perpendicular in the present, and oblique in the next: yet the specimen β—d would invalidate even this character. The head and thorax of the next are proportionally a little larger, and the thorax seems more narrowed behind, and less tubulated in front by the anterior constriction, but these differences are not very obvious.

14. C. purpurea, supra varicolor, thorace marginibus (exemplis nigris exceptis) viridibus, capiteque disco sæpius purpureo-cupreis, valde rugosis, elytris elevato-punctatis, sutura sæpissime virescente, fascia paulo sinuata subobliqua ad medium, lunulaque apicali sæpius interrupta albis, limbo laterali (exemplis nigris exceptis) late viridi minus distincte punctato, margine extimo cuprascente. Long. ·5—·6.

a. Capite thoracis elytrorumque disco purpureo-cupreis. *C. purpurea* Oliv. Ins. 33, No. 11, tab. 3, fig. 34: Herbst, Käfer, 10, 195; tab. 173, fig. 7: Say, Trans. Am. Phil. Soc. 1, 419, tab. 13, fig. 8: Gould, Bost. Journ. Nat. Hist. 1, 44. *C. marginalis* Fabr. Syst. El. 1, 240: Herbst, Käfer, 10, 175; tab. 171, 10: Dej. Sp. Gen. 1, 55; 5, 210.

b. Capite thoracisque disco æneo-cupreis, elytris olivaceis.

c. Nigra, labro maculisque solitis albis. *C. Audubonii* Lec. Bost. Journ. Nat. Hist. 5, 207; tab. 18, fig. 7; Ann. Lyc. Nat. Hist. 4, 176.

Variety a. is extensively diffused through the middle and Western States: varieties b. and c. occur only at the West. I have them from Lake Superior, Wisconsin, and Nebraska: in the last mentioned region the type did not occur. A specimen with dull green elytra and coppery reflections, which seems intermediate between a and b, occurred at New York.

GROUP VII.

Contains species of robust form, and mostly of large size; above of the usual metallic brown colour, but sometimes of a fine copper or purple colour. The labrum is moderately large, three toothed, almost always prominent in the middle; with the lateral angles obtuse. The labial palpi of the male are pale, with the last joint black. The head and thorax are finely granulate, the former is finely striate at the sides, with scattered white erect hairs on the front: the latter is usually convex, narrowed behind, with erect hairs towards the sides. The elytra are punctured, very finely, sometimes hardly perceptibly serrate towards the tips, which are conjointly rounded in both sexes, with a small sutural spine. The markings are usually broad; the humeral lunule is always entire and prolonged; the middle band almost rectangularly bent; the apical lunule entire: sometimes the whole outer margin is white. The under surface is with the exception sometimes of the middle of the pectus and abdomen, clothed with long coarse white hair: the anterior tarsi of the male are moderately broadly dilated.

Species inhabiting sandy places, and seen only when the sun is brightly shining. This group seems closely related to group VIII., but in that the labrum is almost truncate anteriorly, and the thorax is quadrate and less convex, and the elytra are more strongly serrate. Three principal forms.

1. Elytra dull, middle band dilated on the margin: (labrum 3-toothed, prominent.) C. Ancocisconensis, venusta, generosa, formosa, latesignata.

2. Elytra dull, spots not connected at the margin: (labrum 3-toothed, subtruncate.) C. vulgaris.

3. Elytra shining, spots not connected: (labrum prominent, obsoletely toothed.) C. fulgida.

C. Ancocisconensis affiliates by its markings with C. baltimorensis; while C. vulgaris is evidently by the labrum and form of body allied to C. purpurea, which differs by the entirely black palpi, the interrupted humeral lunule, and the not serrate elytra.

15. C. Ancocisconensis supra æneo-brunnea, capite granulato, fronte albosetosa, utrinque subtiliter striata, thorace convexo, latitudine paulo breviore, postice subangustato, granulato, lateribus parce albo-setosis, elytris punctatis, ad apicem rotundatis obsolete serratis, lunula curvata humerali, altera apicali superne inflexa fascia angusta media obtuse refracta lineæ marginali adjuncta albis; subtus viridi-æneca lateribus minus dense albo-setosis; labro sexus utriusque longiusculo, albo, tridentato. Long. ·6.

Mas palpis labialibus articulo penultimo pallido.

Harris, Family Visitor, (Cleveland, Ohio,) 2, No. 39. Haldeman, Proc. Acad. Nat. Sc. 6, 361.

Found about the White Mountains, New Hampshire, by Dr. T. W. Harris, to whom I owe a fine series of specimens: a specimen was previously given me by Mr. Schafhirt, who found it in one of the public squares of Philadelphia. This species is very distinct from all other native species: the markings of the elytra resemble nearly in form those of C. repanda. Haldeman has stated that the maxillary palpi of the male are pale at base: this is undoubtedly an error of writing, as the labial palpi are meant.

16. C. venusta, cuprea, opaca, capite thoraceque granulato-rugosis, viridi variegatis, fronte albo-setosa, utrinque striata, thorace convexo, latitudine breviore, postice subangustato, lateribus longe albo-setosis, elytris punctatis versus basin parce granulatis, ad apicem subtiliter serrulatis, lunula humerali oblique prolongata, fascia media perpendiculariter refracta, lunulaque apicali latis ad marginem cohærentibus albis, limbo extimo epipleurisque æneo-viridibus; subtus viridi-ænea longe albo-pilosa, pectore medio glabro: labro sexus utriusque albo maiusculo, prominulo subtiliter tridentato. Long. ·55—·60.

Mas palpis labialibus articulo penultimo pallido.

Leconte, Ann. Lyc. Nat. Hist of New York, 4, 179; tab. 13, fig. 6.

On sandy places near the Forks of Platte River. More slender and more convex than C. generosa, and distinguished by the larger and more prominent labrum.

17. C. generosa, crassiuscula, supra fusco-ænea, vel nigro-purpurea, opaca, capite granulato-rugoso, fronte striata albo-setosa, thorace latitudine breviore, granulato-rugoso postice subangustato, lateribus albo-setosis, elytris punctatis parce granulatis, ad apicem subtilissime serratis, lunula humerali oblique prolongata, fascia media perpendiculariter refracta, lunulaque apicali antice inflexa latis, albis ad marginem cohærentibus, limbo extimo epipleurisque æneis; subtus viridi-ænea, longe albo-pilosa, pectoris abdominisque medio glabro, pleuris purpureo-variegatis; labro sexus utriusque albo medio prolongato, tridentato. Long. ·6—·7.

Mas thorace convexo, postice subangustato, palpis labialibus articulo penultimo pallido.

Femina thorace minus convexo postice vix angustato, palpis labialibus articulo penultimo piceo.

Dej. Sp. Gen. 5, 231: Gould, Bost. Journ. Nat. Hist. 1, 42; tab. 3, fig. 2.

C. obliquata ‡ Kirby, Fauna Bor. Am. 4, 10.

Variat maculis albis latioribus, ita ut lunulæ humeralis margo posticus marginem perpendiculariter ferit; lunula postica quoque lobata haud inflexa apparet.

Middle and Western States, (Connecticut, Pennsylvania, Wisconsin, Minnesota.) The variety is rare: but at a locality on the Mississippi above the Falls of St. Anthony I found them quite abundant: in one specimen the markings are fully as dilated as in C. formosa, from which it differs only by the middle band being rectangularly bent.

18. C. formosa, crassiuscula, supra cuprea, vel cupreo-purpurea, opaca, capite granulato-rugoso, fronte striata albo-setosa, thorace latitudine breviore granulato-rugoso, postice subangustato, lateribus albo-setosis, elytris punctatis parce granulatis ad apicem vix serrulatis, lunula humerali, fascia media obtuse sinuata lunulaque apicali dilatatis albis ad marginem late cohærentibus, limbo externo epipleurisque æneis; subtus viridi-ænea albo-pilosa, pectoris abdominisque medio glabro; labro sexus utriusque albo, medio paulo prolongato tridentato. Long. ·64—·7.

Sexus differentia sicut in C. generosa.

Say, Journ. Acad. Nat. Sc. 1, 19; Am. Ent. tab. 18; Dej. Sp. Gen. 2, 424; Lec. Ann. Lyc. 4, 180.

Valley of the Nebraska River, near sand hills. The marks of the elytra are always very broad, and the humeral lunule, though obliquely prolonged, is so dilated that its posterior outline is perpendicular to the sides: the only satisfactory difference between it and C. generosa is found in the middle band being only obtusely bent, and much less deflexed than in the last named species.

19. C. latesignata, supra fusco-nigra opaca, capite thoraceque granulatis rugosis æneo-tinctis, fronte subtilius striata albo-setosa, thorace latitudine breviore, postice vix angustato, parum convexo, lateribus albo-setosis, elytris

fortius punctatis, ad apicem rotundatis vix serrulatis, lunula humerali oblique prolongata, apicali antice inflexa fasciaque media rectangulariter refracta, ad marginem expansa, latis albis; subtus viridi-ænea, longe pilosa, pectore medio glabro: labro sexus utriusque breviusculo, medio tridentato parum prominulo. Long. ·5.

Mas palpis labialibus articulo penultimo pallido.

Femina palpis concoloribus, (thorace elytrisque adhuc minus convexis.)

Leconte, Ann. Lyc. Nat. Hist. of New York, 5, 172. Chaud. Bull. Mosc. 1854.

Variat maculis elytrorum latissimis confluentibus.

San Diego, California, on the sea shore, and in salt marsh. Though allied to C. generosa, the form is less convex, the elytra are more strongly punctured, and the labrum is shorter. Baron Chaudoir states that it closely resembles the Asiatic C. lateralis.

20. C. vulgaris, æneo-fusca opaca, fronte striata albo-setosa, capite thoraceque granulatis rugosis, hoc latitudine plus sesqui breviore, parum convexo, trapezoideo, fortiter transversim impresso, lateribus parce albo-pilosis, elytris punctatis, parce granulatis, parum convexis, ad apicem obsoletissime serrulatis, lunula humerali oblique prolongata, apicali antice inflexa, fasciaque media rectangulariter refracta angustis albis; subtus viridi-ænea longe minus dense albo-setosa, pleuris cupreis; labro sexus utriusque albo breviusculo tridentato. Long. ·52—·65.

Mas palpis labialibus articulo penultimo pallido; labro minus acute dentato.

Say, Trans. Am. Phil. Soc. 1, 409; tab. 13, fig. 1. Kirby, Fauna Bor. Am. 4, 10: Gould, Bost. Journ. Nat. Hist. 1, 43.

C. obliquata Dej. Sp. Gen. 1, 72.

Variat. a. Lunula humerali fere obsoleta.

b. Viridis, macula humerali interrupta. Lec. Ann. Lyc. 4, 179.

Apparently found in almost every part of the United States. New York, Georgia, Wisconsin, Missouri. The green specimen was found by Dr. Townsend on his journey to the Pacific, through the Rocky Mountains, and was given me by Mr. Willcox. The variety with indistinct humeral lunule was taken on the banks of the Ohio River, below Louisville. In form this species entirely resembles C. purpurea, and bears but a remote resemblance (except in the forms of the markings) to C. generosa. The description given by Kirby of C. obliquata can however be referred to no other species but C. generosa, from which he separates the present by a number of characters of little value, neglecting the obvious differences.

21. C. fulgida, purpureo-cuprea, capite thoraceque rugosis, fronte striata albosetosa, antice viridi, thorace convexo, latitudine parum breviore postice subangustato, lateribus albosetosis, elytris valde punctatis nitidis, ad apicem subtilissime serrulatis, lunula humerali oblique prolongata, fascia media rectangulariter flexa, lunulaque apicali antice inflexa latis albis; subtus viridi-ænea ad latera longe albopilosa; labro breviusculo, medio prominulo subtilius tridentato. Long. ·5.

Mas palpis labialibus articulo penultimo pallido; labro vix obsolete dentato.

Say, Journ. Acad. Nat. Sc. 3, 141: Lec. Ann. Lyc. Nat. Hist. of New York, 4, 179; tab. 13, fig. 5.

Platte river valley on sandy places. In one specimen the middle band of the elytra is slightly dilated along the margin (as may be occasionally seen in C. vulgaris) but it would never become united with either of the lunules. The form of this species is more slender than that of C. generosa &c.

GROUP VIII.

Contains several species of a not slender form, with the thorax subquadrate and more flattened in the females than the males: the elytra are strongly punctured with intermixed granules, they are rounded and finely serrate at tip; in the females they are more or less dilated on the sides; the spots are normal, sometimes interrupted, sometimes connected on the margin, the medial band is perpendicularly bent. The head and thorax are finely rugous and granulate, the front is finely striate near the eyes, and is pilose in our native species; the labrum is moderately short, the middle tooth being acute and prominent, while the others are indistinct, and frequently wanting. The labial palpi at least of the male are pale at base. Sides of the thorax and body beneath hairy.

The species may be divided into three principal forms:

1. Lunules interrupted, middle band not dilated on the margin. C. oregona and guttifera.

2. Middle band dilated on the margin, humeral lunule curved, sometimes interrupted. C. 12-guttata and baltimorensis.

3. Middle band dilated on the margin, humeral lunule perpendicularly bent. C. hirticollis.

22. C. oregona, fusco-ænea, vel cyanea, fronte parce pilosa, utrinque subtiliter striata, thorace latitudine breviore, subquadrato, postice vix angustato, elytris pone humeros obtusos sensim latioribus, postice fortiter serratis, spina suturali prominula, punctatis granulatis, lunulis late interruptis, fascia media rectangulariter refracta ad marginem haud latiore albis; subtus cyaneo-ænea, pleuris albo-pilosis; labro albo unidentato. Long. ·4—·55.

Mas palpis labialibus articulo penultimo pallido. Femina elytris magis dilatatis, palpis concoloribus nigris.

C. duodecimguttata ‡ Ménétriés, Bull. Soc. Imp. St. Petersb. 2, 52; et auctorum aliorum, (sine descriptione.)

Oregon Territory and Northern California, as far as San Francisco. Of the same form as C. 12-guttata, but having the elytra of the female more dilated, and the apical serratures and the sutural spine much more distinct.

The white spots of the elytra are large and conspicuous, but show no tendency to unite along the margin; they are thus placed: a humeral spot; a middle fascia bent at a right angle, and then curved towards the suture, terminating in a round spot: an apical spot, and two round submarginal spots, one midway between the humerus and middle band, the other between the band and the tip, but rather nearer the latter. The specimens from Oregon were collected by Dr. J. G. Cooper, they are all blue, or of a dull olive green above: the specimen found by me at Benicia is above of a fuscous bronze colour varied with coppery and brassy, as in our common C. baltimorensis.

22′. C. ——, capite omnino sicut in præcedente, thorace—? elytris fortius punctatis, ad apicem serratis, spina suturali prominula, lunulis humerali apicalique interruptis, fascia media oblique oriente, obtuse refracta.

Here seems the proper place to refer some fragments of a specimen collected by Dr. Cooper at Prairie Pass, Oregon. The head is not in the least respect different from that of the preceding, but the elytra are less dilated and less strongly serrate: the surface is more strongly punctured, and the middle band does not arise perpendicularly (as in all

the other species of this group) but is oblique, and only obtusely bent, terminating, however, as in the preceding, in a round spot. The body beneath is bluish green. I have already indicated this species (Proc. Acad. Nat. Sc. 7, 16) as perhaps allied to C. longilabris, but on farther examination it appears to have no relation to that species.

23. C. guttifera, fusco-ænea, fronte parce pilosa, utrinque subtiliter striata, thorace latitudine breviore subquadrato, postice vix angustato, elytris pone humeros obtusos sensim latioribus, postice rotundatis subtilius serratis, spina suturali parva haud prominula, punctatis granulatis, lunulis late interruptis, fascia media rectangulariter refracta, ad marginem haud latiore albis, subtus viridi-ænea, pleuris omnibus cupreis albo pilosis; labro albo unidentato. Long. ·5.

Mas latet.

Santa Fe, New Mexico, collected by Mr. Fendler. Resembles precisely in its form and markings C. oregona, but differs in having the tip of the elytra less serrate, and the sutural spine not prominent. The copper pleuræ afford also a good character for its separation: these are, however, found in C. 12-guttata, from which the present differs by the middle band being not at all dilated on the margin, and by the completely isolated spots into which the lunules are divided.

24. C. duodecim-guttata, supra nigra, fusco-ænea, vel etiam cuprascens et cyanea, fronte parce pilosa, utrinque subtiliter striata, thorace latitudine breviore subquadrato, postice subangustato, lateribus albo-pilosis, elytris pone humeros sensim latioribus, postice rotundatis subtilius serratis, spina suturali haud prominula, granulatis punctatis, (punctis sæpe vix distinctis,) lunula humerali curvata apicalique sæpe interruptis, fasciaque media rectangulariter refracta, in striga marginali oriente albis; subtus viridi, vel cyaneo-ænea, lateribus albo-pilosis, pleuris cuprascentibus, labro albo unidentato. Long. ·47—·54.

Mas palpis labialibus articulo penultimo pallido: femina palpis concoloribus, elytris latioribus.

Dej. Sp. Gen. 1, 73; Gould, Bost. Journ. Nat. Hist. 1, 51; tab. 3, fig. 3.

C. Proteus Kirby, Fauna Bor. Am. 4, 9.

Lake Superior, New York, near water, usually on causeways over marshes, or on the shores of lakes. Varies considerably, not only in the spots, which are sometimes entire, and sometimes interrupted, or even obsolete, but also in colour, as mentioned in the diagnosis: the sculpture too varies, because in the specimens of a black colour, the punctures vanish, and the elytra seem only sparsely granulate. When the colour is bronzed olive or coppery, the punctures are blue, and are very distinct.

Perfectly marked specimens, as well as those of coppery and greenish colour, have been found by me, only at Lake Superior: but a remarkable specimen of a fine blue colour with very complete marks was taken by Dr. Kirtland at Fort Gratiot, and kindly presented to me. Those found near the Atlantic vary but little, being of a dull blackish bronze colour, with the marks interrupted: the marginal white line connected with the middle band disappears occasionally, but the markings of the middle band are then extremely small and imperfect, so that even such specimens could not be confounded with the two preceding species.

The most perfectly marked specimens greatly resemble the next species, but are readily known by the shorter and less convex thorax, and by the elytra of the female being only gradually dilated, behind the shoulders, and by the black maxillary palpi of the male.

25. C. baltimorensis, fusco-ænea, fronte utrinque subtiliter striata, parce pilosa, thorace subquadrato, convexiusculo, lateribus albo-pilosis, elytris pone humeros latioribus punctatis granulatis, ad apicem rotundatis serrulatis, spina suturali prominula, lunula humerali curvata, altera apicali antice inflexa, fasciaque media rectangulariter fracta in linea marginali oriente albis; subtus viridi-ænea, lateribus pilosis, pleuris cupreis; labro brevi unidentato; palpis labialibus sexus utriusque articulo penultimo pallido. Long. ·47.

Mas palpis pallidis articulo ultimo nigricante, elytris subparallelis.

Femina palpis maxillaribus nigris, elytris pone humeros subito paulo latioribus.

Herbst, Käfer, 10, 180, tab. 172, fig. 3.

C. repanda Dej. Sp. Gen. 1, 74: Kirby, Fauna Bor. Am. 4, 9, tab. 3, fig. 1.

C. hirticollis‡ Gould, Bost. Journ. Nat. Hist. 1, 49.

Lake Superior, New York, Missouri, Georgia. Does not vary perceptibly in its characters; the marginal line of the elytra never reaches either of the lunules. One specimen occurred at New York having the middle fascia abbreviated at tip, so as to be less strongly bent than usual. I do not know how Herbst's description of this species has been overlooked, for it is quite satisfactory.

26. C. hirticollis, olivaceo-ænea cyaneo variegata, vel fusco-ænea, vel fusca vix ænescens, fronte albosetosa, utrinque striata, thorace quadrato postice haud angustato lateribus valde pilosis, elytris fortius punctatis (punctis sæpissime cyaneis,) ad apicem oblique rotundatis, serratis spina suturali prominula, lunula humerali perpendiculariter flexa et hamata, apicali antice inflexa, fascia media subito fere acute refracta in striga marginali lunulæ humerali adjuncta albis; subtus cyaneo-viridis, lateribus valde pilosis, pleuris cupreis; labro brevi medio prominulo unidentato; palpis omnibus sexus utriusque pallidis articulo ultimo æneo. Long. ·45—·62.

Mas elytris pone humeros vix latioribus.

Femina elytris pone humeros subito rotundatim paulo dilatatis.

Say, Journ. Acad. Nat. Sc. 1, 20. Trans. Am. Phil. Soc. 1, 411, tab. 13, fig. 2. Kirby, Fauna Bor. Am. 4, 8.

Le Conte, Ann. Lyc. Nat. Hist. 4, 180: Chaud. Bull. Soc. Imp. Nat. Mosc. 1854.

C. albohirta Dej. Sp. Gen. 2, 425: Gould, Bost. Soc. Nat. Hist. 1, 49, tab. 3, fig. 1.

C. gravida Lec. Ann. Lyc. Nat. Hist. 5, 170.

C. unita Kollar, Ann. Wien. Mus. 1, 330.

Variat maculis plus minusve obliteratis; etiam linea marginali lunulam apicalem vel attingente, vel abbreviata.

Found abundantly on the shores of both of the Atlantic and Pacific oceans, and the Gulf of Mexico, along our whole coasts; also on Lakes Ontario, Erie, and Superior: specimens occur, though less abundantly, on the rivers of the central and western parts of the Continent; *e. g.* Platte, Arkansas and Gila. The synonym last named was made on specimens from California, and presented slight differences which with a larger series of specimens have disappeared.

The figure and description given by Say in the Trans. Am. Phil. Soc. represent perfectly this species, but the short description in the Journal of the Academy is very indefinite, and

with the false locality, (Pennsylvania,) has led several entomologists to suppose it intended for the preceding species: it is quite likely that Say at that time confounded them together, but the expressions, "thorax very hairy," and "band is divaricated on the margin, so as to join the anterior lunule," lead me to refer the description to the present species.

GROUP IX.

One species of a slender form, with the labrum moderate, with the middle tooth prominent: palpi pale with black tips: head bald, slightly striate each side: thorax subcylindrical, hairy at the side. Elytra punctured, with long slender markings, medial band slightly bent, oblique, connected with a marginal white line; tips rounded finely serrate: those of the female very slightly suddenly dilated. Body beneath with dense not erect white hair, middle of pectus and abdomen glabrous.

Affiliates with group XII., but the humeral lunule is not recurved, the trochanters are not red, and the head is not pubescent. Also with the next group—but the tips of the elytra are serrate, and the middle tooth of the mandibles is not smaller than the others.

This group has most of the essential characters of the preceding, and is distinguished from C. baltimorensis by its slender form, and very elongated and oblique medial band; it leads through the next to others hereafter treated of, and interrupts the passage to group XI., which should properly follow group VIII.

27. C. tenuisignata, elongata, fusco-ænea, capite glabro subtiliter granulato, prope oculos striato, thorace latitudine haud breviore, subcylindrico, vix canaliculato, subtiliter granulato, pilis haud erectis ad latera parce vestito, elytris punctatis, antice parce granulatis ad apicem rotundatis serratis, spina suturali prominula, lunula humerali curvata, apicali antice inflexa, linea media elongata obliqua obtuse angulata in striga marginali quæ lunulas haud attingit oriente, tenuibus albis; subtus viridi-ænea, lateribus pube depressa dense vestita, pleuris cuprascentibus; labro brevi albo unidentato, palpis sexus utriusque pallidis articulo ultimo æneo. Long. ·43—·47.

Leconte, Ann. Lyc. Nat. Hist. of New York, 5, 171, (1852.)

? *C. californica* Ménétriés, Bull. Soc. Imp. St. Petersb. 2, 52, (1843.)

New River, Colorado Desert, California: found also in Texas on the Rio Grande by Mr. Schott, of the Boundary Commission, and by Dr. Berlandiére. The description given by Mr. Ménétriés of C. californica applies to this species so far as it goes, but it is extremely imperfect, and I do not feel authorized in suppressing the name given by me. I may add that Mr. Motschulsky, who possesses a specimen of C. californica, failed to recognise the species in my collection. In order, however, to save a reference to a rare work, I copy the original description.

'C. californica, parallela, obscure ferruginea subtus albo-pilosa; elytris lunula humerali, apicalique integris, fascia media extus dilatata (lunulam humeralem fere attingente) intus hamulo oblique descendente albis; pedibus gracilioribus longissimis.

'Cette espèce a quelque ressemblance avec la *C. spinigera* Eschsch. de son Atlas zoologique, mais elle est

beaucoup plus étroite, plus parallèle et la lunule du milieu se dilate sur le bord externe, de manière à rejoindre presque la lunule humérale et descend extérieurement aussi bas que la branche antérieure de la lunule apicale; de plus la lunule du milieu, partout d'égale largeur, descend obliquement jusqu' au deux tiers de la largeur de l'élytre; les jambes sont très longues et grèles. Le dessous du corps est couvert de poils blancs très serrés.'

GROUP X.

Moderate-sized, subcylindrical, but somewhat robust species, with sericeous surface rarely with any metallic gloss. Head glabrous, striate each side. Labrum short with one prominent, and two obsolete teeth. Palpi pale with darker tips in the male or in both sexes. Thorax quadrate, rounded, or subcylindrical, hairy on the sides. Elytra not serrate, conjointly rounded in the male, with the suture slightly retracted in the female. The medial band is oblique, and long: the humeral lunule is also prolonged: these markings are frequently connected by a broad white marginal band, but the white is separated from the outer edge by a stripe of black, which is quite conspicuous. From this it results, that in the varieties with obsolete markings the medial band does not reach the margin as usual. The under surface is metallic green, slightly hairy on the sides; the anus is black: the tibiæ are usually testaceous at base.

The middle tooth of the the mandibles is smaller than the others, though not so conspicuously so as in group XXI.

28. C. imperfecta, supra fusco-atra opaca sericea, ænescens, capite utrinque striolato, thorace quadrato, postice subangustato, lateribus parce pilosis, elytris viridi-punctatis, lunula humerali oblique valde prolongata, apicali antice inflexa, fasciaque media elongata obliqua sinuata extrorsum abbreviata albis, subtus viridi-ænea, lateribus subtilius pilosis; labro brevi albo unidentato, palpis maxillaribus (feminæ) nigro æneis, labialibus pallidis articulo ultimo æneo.Long. ·45.

Leconte, Ann. Lyc. Nat. Hist. 5,171.

One female from Sacramento. The maxillary palpi of the male are undoubtedly pale with dark tip as in the other species of this group.

29. C. pusilla, atra opaca, haud ænescens, capite utrinque striato, thorace latitudine vix breviore, lateribus rotundatis pilosis, postice angustato, elytris pone humeros sensim latioribus, parce punctatis, lunula humerali curvata, apicali antice inflexa, strigaque media obliqua extrorsum dilatata tenuibus albis, subtus ad latera parce pilosa; tibiis ad basin pallidis; labro albo tridentato, palpis sexus utriusque pallidis apice nigricantibus. Long. ·45.

Say, Journ. Acad. Nat. Hist. 1, 31. Trans. Am. Phil. Soc. 1, 424; tab. 13. Dej. Sp. Gen. 2, 432: Lec. An. Lyc. Nat. Hist. 4,183. Variat elytris nigris immaculatis

Platte River valley, on moist mud.

30. C. cinctipennis, supra olivacea, vel fusco-ænea, vel atra, sericea, capite utrinque striato, thorace latitudine vix breviore, lateribus rotundatis albo-pilosis, postice angustato, elytris subparallelis, fortius punctatis, lunula humerali curvata, apicali antice inflexa, fasciaque media obliqua sinuata extrorsum in linea submarginali oriente albis; subtus viridi-ænea lateribus parcius albo-pilosis, tibiis ad basin testaceis; labro brevi albo tridentato; palpis sexus utriusque pallidis articulo ultimo nigro. Long. ·45.

Leconte, Ann. Lyc. Nat. Hist. 4, 182.

Variat maculis elytrorum late confluentibus, ita ut vitta lata submarginalis efformatur ramo antico obliquo, altero ad medium sinuato, loboque anteapicali rotundato prædita. Loc. cit. tab. 14, fig. 12.

Platte and Arkansas River on muddy plains. Nearly allied to the preceding, from which the more strongly punctured and more parallel elytra, and the complete white markings distinguish it. The trochanters are usually dark testaceous.

31. C. cyanella, gracilis, obscure cyanea, sericea, capite utrinque striato, thorace latitudine fere longiore, lateribus subrotundatis albo-pilosis, postice subangustato, elytris fuscis pone humeros sensim latioribus, fortius cyaneo-punctatis, lunula humerali curvata, apicali antice inflexa, guttaque ad medium brevi submarginali intus prominula albis; subtus ad latera albo-pilosa, tibiis medio obsolete testaceis; labro albo brevi subtridentato, palpis (maris) pallidis articulo ultimo nigro, maxillaribus basi piceis. Long. ·36.

One specimen collected at the Yellowstone River, Upper Missouri, by Dr. Hayden. Related to the two preceding, but distinguished by its smaller size, and more slender form. From C. cinctipennis it differs in having the elytra with the form and markings of C. pusilla, and from the latter by the deep and large punctures. The maxillary palpi are brownish at the base, but this may be an individual variation: the anus and trochanters are testaceous.

GROUP XI.

Maritime species having broad depressed white elytra, which are angulated laterally in the female: the suture and oblique lines are dark metallic green. The thorax of the female is dilated posteriorly: the front is glabrous, finely striate; in our species the right mandible of the male is inferiorly dilated into an obtuse tooth near the tip, but in the South American C. nivea, this is not observed. The palpi are pale with dark tips. The body beneath is densely clothed with white hair, only the middle of the pectus and abdomen is glabrous. Legs very long; first joint of anterior tarsi of males hardly dilated, 3rd joint very perceptibly oblique; claws larger than usual. The tips of the elytra are obliquely narrowed, and separately rounded in the female, but in the male they are conjointly rounded. The change in pattern of the elytral markings is owing to the presence of a basal spot; the ordinary markings are broad, and the humeral lunule is prolonged along the suture till it reaches the much deflexed and somewhat tortuous medial band.

32. C. dorsalis, capite thoraceque olivaceo-æneis, subtiliter rugosis, illo glabro fronte vage bisulcata utrinque striolata, thorace albo-pubescente, latitudine breviore lateribus late rotundatis, elytris punctatis ad apicem serrulatis, albidis, sutura lineisque tribus viridi-æneis (anteriore semper cum sutura confluente;) subtus ænea dense albo-pubescens, pectore medio abdomineque glabris, hoc purpurascente ano testaceo: labro amplo albo unidentato, palpis pallidis apice nigro-æneis. Long. ·55—·6.

Mas mandibulo dextro subtus longe dentato; thorace postice vix ampliato; elytris lateribus late rotundatis.

Femina thorace postice ampliato, angulis productis; elytris pone humeros distincte angulatis, margine paulo explanato.

Say, Journ. Acad. Nat. Hist. 1, 20; Trans. Am. Phil. Soc. 1, 415; tab. 13, fig. 5: Gould, Bost. Journ. Nat. Hist. 1, 47.

C. signata Dej. Sp. Gen. 1, 124.

Variat elytris albidis sutura sola viridi-ænea, (mas.)

Atlantic coast of Middle and Northern States; very abundant on the open sandy seashore.

33. C. media, olivaceo-ænea, capite glabro, fronte vage bisulcata utrinque striolata, thorace latitudine haud breviore, albopubescente lateribus parum rotundatis, elytris punctatis albidis, sutura lineisque obliquis tribus (anteriore cum sutura confluente) viridi-æneis, ad apicem serrulatis, subtus viridi-ænea dense albo-pubescens, pectore abdomineque medio glabris, ano testaceo, labro amplo albo unidentato, palpis pallidis ad apicem nigro-æneis. Long. ·48—·53.

Mas thorace postice haud latiore, elytris lateribus rotundatis; mandibulo dextro subtus longe dentato.

Femina thorace postice paulo ampliato, angulis productis; elytris pone humeros angulatis, margine parum explanato.

Sea coast of Georgia, and South Carolina. Very similar to the preceding, but always smaller: the narrower and less rounded thorax and the narrower elytra induce me to consider it as a separate species. The sexual characters are precisely as in C. dorsalis. The posterior one of the three oblique lines of the elytra is frequently connected with the suture.

34. C. Saulcyi, olivaceo-ænea, capite glabro, fronte vage bisulcata, utrinque striolata, thorace latitudine haud breviore, albopubescente lateribus rotundatis, elytris punctatis albidis, sutura lineisque tribus obliquis (sæpe cum sutura coniunctis) viridi-æneis, ad apicem serrulatis, subtus viridi-ænea dense albopubescens, pectore abdominisque medio glabris, ano testaceo, labro amplo albo unidentato, palpis pallidis ad apicem nigro-æneis.

Mas thorace postice vix ampliato, elytris lateribus late rotundatis; mandibulo dextro subtus breviter obtuse dentato. Long. ·36—·41.

Femina thorace postice valde ampliato, angulis paulo productis, elytris pone humeros obtuse angulatis vix explanatis. Long. ·37—·43.

Guérin, Rev. Zool. 1840, p. 37; 1841, 96.

C. venusta Ferté, Rev. Zool. 1841, 37.

Variat elytris albidis sutura sola ænea; femina.

Sea shore of the Gulf of Mexico (Texas, Louisiana, Florida:) the variety was found at Key West, by Dr. W. L. Jones. This species is also very closely related to the two preceding, and except by the difference in size and in the form of the inferior tooth of the right mandible of the male, is hardly separated from C. dorsalis. The elytra are however narrower in both sexes, and the thorax is somewhat longer and less rounded on the sides. The bronze markings of the elytra are usually much broader, and the posterior one is frequently lobed.

GROUP XII.

Maritime, salt marsh, or fluviatile species, having the right mandible of the male sometimes toothed near the tip, as in the preceding group, but sometimes, (form 2,) normal.

The thorax has more or less elevated posterior angles, and in the female is sometimes wider towards the base. The form is nearly cylindrical, the front is hairy, finely striate each side. The elytra of the female are somewhat wider than those of the male. The markings are either narrow or wide; the humeral lunule is recurved posteriorly, the middle band is long and fimbriate, sometimes tortuous; the whole lateral margin is white, the apical lunule is lost in the white margin, but is slightly dilated at the suture and at the anterior extremity; they are also marked, except in C. sperata, with a large basal spot: the tips are feebly serrate. The body beneath is densely clothed with white hair, with the middle of the pectus and the abdomen glabrous. The legs are long, and the trochanters are red. The labrum is three-toothed, but the middle tooth is more prominent; the palpi are pale with dark tips.

Two principal forms may be distinguished:

1. Salt water species having the elytra rounded on the sides, with the suture of the female retracted, and the tips separately rounded. C. lacerata and marginata.

2. Fluviatile species with cylindrical elytra, which in the female are obliquely sinuate and armed with an external tooth near the tip. C. cuprascens, blanda, macra, sperata.

35. C. lacerata, olivaceo-ænea, capite thoraceque subtiliter albo-pubescentibus, hoc quadrato, latitudine sublongiore, elytris latiusculis confertim punctatis, macula basali, margine lato lobato, ramo humerali subobliquo hamato, fascia media refracta elongata fimbriata, lunulaque apicali utrinque inflexa albis, ad apicem serrulatis singulatim rotundatis, spina suturali distincta; subtus dense albo-pubescens, medio glabra, pedibus longissimis, trochanteribus rufis; labro albo unidentato. Long. ·42—·45.

Mas thorace lateribus vix rotundatis, mandibulo dextro dente inferiore obtuso armato; elytris sutura modice retracta.

Femina thorace lateribus paulo rotundatis; elytris sutura valde retracta

Chaudoir, Bull. Soc. Imp. Moscow, 1854.

Louisiana and Florida, on the coast of the gulf of Mexico. Quite distinct from the following by the broader elytra of the female not being deflexed at tip, and by the inferior tooth of the right mandible of the male being obtuse, and by the difference in the apical angles of the elytra.

36. C. marginata, olivaceo-ænea, capite thoraceque subtilius albo-pubescentibus, hoc quadrato, elytris confertim punctatis ad apicem serrulatis, macula basali, margine lato lobato, ramo subhumerali subobliquo hamato, fascia media longa refracta fimbriata, lunulaque apicali utrinque inflexa albis; subtus dense albo-pubescens, medio glabra, trochanteribus rufis, pedibus elongatis; labro albo unidentato. Long. ·43—·55.

Mas thorace postice haud latiore, mandibulo dextro dente elongato inferiore armato, elytris spina suturali prominula.

Femina thorace postice subampliato, elytris sutura valde retracta ad apicem deflexis.

Fabr. Syst. El. 1, 241: Herbst, Käfer, 10, 206: Say, Trans. Am. Phil. Soc. 1, 417; tab. 13, f. 6: Gould, Bost. Journ. Nat. Hist. 1, 48.

C. variegata Dej. Sp. Gen. 1, 84.

Variat maculis obsoletis, margine lato, maculaque basali utrinque relictis.

On salt marsh in Massachusetts and New York: on the ocean beach of South Carolina and Georgia. The specimens from the latter localities are more perfectly marked, and the lobe representing the anterior extremity of the apical lunule is directed more obliquely inwards than in specimens from New York; but after a close comparison I have failed to find any specific differences.

37. C. cuprascens, modice elongata, cylindrica, cuprea, vel olivaceo-ænea, subnitida, capite thoraceque albo-pubescentibus, hoc latitudine haud longiore, lateribus rotundatis, elytris valde punctatis ad apicem serrulatis, macula basali, margine lobato, ramo subhumerali subobliquo hamato, fascia media fere tortuosa fimbriata, lunulaque apicali utrinque inflexa latis albis; subtus viridi-ænea dense albo-pubescens, medio glabra, trochanteribus rufis, pedibus longissimis; labro brevi unidentato. Long. ·48—·52.

Mas elytris ad apicem oblique subsinuatis, sutura haud retracta.

Femina elytris ad apicem oblique sinuatis, angulo externo acuto prominulo, sutura paulo retracta.

Lec. Proc. Acad. Nat. Sc. 6, 65.

C. blanda ‡ (var. β.) Lec. Ann. Lyc. Nat. Hist. 4, 180: Chaud. Bull. Mosc. 1854.

Missouri and Kansas: the anterior tibiæ are more or less testaceous. Baron Chaudoir regards this species as a variety of C. blanda; from the imperfections of Dejean's description such an inference might be readily made: it is however very different from the two allied species next described by its stouter form and more rounded thorax, by the more shining surface, by the coarser punctures of the elytra, and by the acute tooth at the external angle of the oblique sinuosity of the elytra of the female. It is quite possible, as many Coleoptera from the Western States have been sent to Europe, that this species has become extensively distributed as the veritable C. blanda *Dej.*

38. C. blanda, elongata subcylindrica, fusco-ænea, haud nitida, capite thoraceque albo-pubescentibus, hoc latitudine paulo longiore lateribus parum rotundatis, elytris subtilius punctatis, ad apicem oblique angustatis serrulatis, maculis albis sicut in priore, at valde dilatatis, (sutura ramisque quatuor obscuris relictis;) subtus dense albo-pubescens, medio glabra, trochanteribus rufis, pedibus longissimis, tibiis tarsisque fere testaceis; palpis pallidis apice obscuris, labro brevi unidentato. Long. ·48.

Mas elytris oblique subsinuatim angustatis sutura prominula. Femina latet.

Dej. Sp. Gen. 5, 238: (var. γ.) Lec. Ann. Lyc. Nat. Hist. 4, 138.

C. tarsalis Lec. Proc. Acad. Nat. Sc. 6, 66.

Georgia and North Carolina, on the banks of rivers. On account of the comparison made between C. blanda and C. variegata (marginata) by Dejean, his description is somewhat obscure; and though possessing the female, he has not noticed the form of the apical sinuosity. Nevertheless I think that the one here described must be regarded as his species, for the following reasons: 1, because a similar specimen was sent to Dr. Harris by my father when the species was first discovered by him; 2nd, because the specimen now in my possession, although from another locality, came from the old collection of my father; and 3, because Dejean states that the white lateral margin of the elytra is wider posteriorly with the lunule obliterated, and that the elytra are less deeply punctured; nei-

ther of which characters is found in C. cuprascens or macra. The white markings are of the same form as in the preceding, but wider, so that the elytra appear white, with the suture as far as the middle and four branches dark-coloured: the first and second branches are oblique forwards and hooked, the third is small, straight and oblique backwards, while the fourth is oblique forwards, thickened at each end, and angulated near the suture.

39. C. macra, valde elongata, cylindrica fusco-ænea, capite thoraceque albo-pubescentibus, hoc latitudine fere longiore lateribus vix rotundatis, elytris confertim punctatis, ad apicem oblique angustatis serrulatis, macula basali, margine lobato, ramo subhumerali obliquo hamato, fascia media tortuosa fimbriata lunulaque apicali utrinque inflexa albis; subtus viridi-ænea, dense albo-pubescens, medio glabra, trochanteribus rufis, pedibus longissimis; palpis sexus utriusque pallidis ad apicem æneis, labro brevi unidentato. Long. ·48—·53.

Mas elytris subsinuatim oblique angustatis, sutura prominula.

Femina elytris magis sinuatim oblique angustatis, angulo externo obtuso haud rotundato, sutura haud prominula.

C. blanda ‡ Lec. Ann. Lyc. 4, 190.

Wisconsin and Minnesota. More slender than C. cuprascens, and readily known by the elytra being more than twice as long as wide, less strongly punctured and not shining: the markings are of the same form, but narrower, and the external angle of the obliquely sinuate elytra of the female is obtuse, or at most rectangular.

40. C. sperata, elongata cylindrica, supra fusco-cuprascens haud nitida, capite thoraceque albopubescentibus, hoc latitudine fere longiore, lateribus parum rotundatis, elytris confertim punctatis, ad apicem oblique angustatis serrulatis, spina suturali prominula, margine, ramo subhumerali obliquo hamato, fascia elongata subtortuosa sæpe fimbriata, lunulaque apicali utrinque inflexa albis; subtus viridi-ænea, dense albo-pubescens medio glabra, pleuris cupreis; pedibus longissimis trochanteribus rufis; palpis et labro ut in prioribus. Long. ·46—·5.

Mas elytris oblique vix sinuatim angustatis: thorace postice haud ampliato.

Femina elytris sinuatim oblique angustatis, angulo externo obtuso haud rotundato; thorace postice perparum ampliato.

Rio Grande, at various places: collected by Messrs. Schott and Clark of the United States and Mexican Boundary Commission. Slightly more elongated than C. cuprascens, and easily distinguished from that as from the other species of this group by the absence of a basal white spot on the elytra. I incorrectly mentioned (Proc. Acad. 6, 439,) this species as C. curvata *Chevr.;* in that species, however, the humeral branch is prolonged backwards parallel with the suture, and is not hamate.

One female specimen varies in having the lateral white margin of the elytra broader, so that the lobes of the apical lunule become wider and rounded.

GROUP XIII.

A small species with large prominent eyes, densely pubescent head and thorax, and pale legs: the elytra are flat, broad and white, with a few sinuous dark lines, the tip is

not at all serrate. Labrum short with one prominent tooth. Palpi of both sexes pale with dusky tips. Body beneath very densely clothed with white hair; middle of pectus and abdomen more thinly pubescent; anus testaceous.

This is the only species known to me having the sutural margin pale.

41. C. lepida, viridi-ænea, capite thoraceque dense albo-pubescentibus, hoc latitudine vix breviore lateribus parum rotundatis, elytris latiusculis minus convexis disperse punctatis, albis lineis utrinque duabus punctisque versus basin fuscis notatis, ad apicem haud serratis, spina suturali haud prominula, subtus dense pubescens, medio glabra, ano testaceo; pedibus antennis palpisque pallidis, his apice fuscis; labro albo unidentato. Long. ·42—·47.

Mas elytris oblique vix sinuatim angustatis.

Femina elytris sinuatim oblique angustatis, angulo externo obtuso haud rotundato apice ipso fere truncato: thorace quam in mare paulo latiore.

Dej. Sp. Gen. 5, 255: Lec. Ann. Lyc. Nat. Hist. 4, 181; tab. 13, f. 8.

Variat elytrorum lineis viridi-æneis.

Coney Island, near New York: Trenton, New Jersey: the variety was found in Missouri, and kindly given to me by Prof. Agassiz, and by Dr. Hoy. This species is found on very white sand, such as is seen forming sand-hills near the ocean.

GROUP XIV.

Maritime or salt marsh species of the ordinary form; the head is glabrous, slightly striate near the eyes, which are very large: labrum one-toothed, short: palpi of both sexes pale with black tips. Thorax very finely granulate, very sparsely hairy. Elytra with narrow markings hardly connected at the margin: middle band very tortuous; margin with a supplementary spot before the apical lunule. Under surface moderately hairy at the sides. Legs moderately long, slender; tarsi of the male as usual.

42. C. ascendens, supra fusco-ænea, thorace distincte subtiliter granulato, elytris disperse profunde viridi-punctatis, lunula humerali inflexa apice hamata, fascia media tortuosa cum linea brevi marginali coniuncta, macula laterali parva lunulaque apicali antice inflexa oblique prolongata vix hamata albis, ad apicem oblique rotundatis serrulatis. Long. ·43.

Leconte, Ann. Lyc. Nat. Hist. 5, 172.

Georgia and West Indies. It is perhaps only a variety of the next, from which it differs only in having the anterior inflexed portion of the apical lunule obliquely prolonged, instead of being bent into a rounded hook.

43. C. serpens, supra fusco-ænea, thorace distincte subtiliter granulato, elytris disperse profunde viridi-punctatis, lunula humerali inflexa subhamata, fascia media tortuosa cum linea marginali coniuncta, macula laterali parva lunulaque apicali antice inflexa et hamata albis, ad apicem serrulatis. Long. ·43—·47.

Mas elytris subparallelis ad apicem oblique rotundatis.

Femina elytris pone medium latioribus ad apicem magis rotundatis.

Leconte, Ann. Lyc. Nat. Hist. 5, 173.

Key West, Florida, Dr. Jones. Differs from C. sigmoidea by the less dense punctures

of the elytra, and from C. tortuosa by the distinctly granulate thorax. Should it be necessary to unite the preceding with this species, let C. serpens be the name retained.

44. C. sigmoidea, supra fusco-ænea, thorace distincte subtiliter granulato, elytris confertim profunde viridi-punctatis, lunula humerali inflexa subhamata, fascia media tortuosa, linea marginali cum fascia et macula laterali coniuncta, lunulaque apicali antice inflexa subhamata albis, ad apicem serrulatis. Long. ·44—·47.

Leconte, Ann. Lyc. Nat. Hist. 5, 172.

C. trifasciata var. Chaud. Bull. Mosc. 1854, 5, 172.

San Diego, California, on the sea-shore. Baron Chaudoir, to whom I sent specimens of this species, regards it as merely a variety of C. tortuosa, which varies somewhat in the width of the elytral markings. The great difference in the punctuation of the elytra, a character found in all the specimens collected, induces me to separate it from C. serpens, while the distinct granulation of the thorax prevents it being joined to the next species.

45. C. tortuosa, supra fusco-atra, thorace subtilissime granulato, elytris disperse viridi-punctatis lunula humerali inflexa, fascia media tortuosa, linea marginali sæpe obliterata, macula marginali lunulaque apicali antice inflexa subhamata tenuissimis albis, ad apicem serrulatis. Long. ·43—·48.

Mas elytris subparallelis.

Femina elytris pone medium latioribus.

Dej. Sp. Gen. 1, 87.

'*C. trifasciata* Fabr.' Klug, Jahrb. 1, 21: Chaud. Bull. Mosc. 1854: Lec. Ann. Lyc. 4, 181; tab. 14, fig. 10.

Georgia and Louisiana, on the mud of rice fields. Besides the finer and almost indistinct granulation of the thorax, the punctures of the elytra are smaller and less deep than in the other species of the group. The white markings are very narrow and frequently interrupted.

The 'C. trifasciata Fabr.' figured by Olivier and Herbst, does not at all resemble this species, nor, as observed by Dr. Harris in a letter to me, can the original words of the Fabrician description 'striga secunda flexuosa' be applied to it, since the same expression is used in the descriptions of C. flexuosa and lurida, in which the middle band is rectangularly bent, as in our C. vulgaris and many others. Moreover, the remark 'Habitat Italia paullo minor,' (Ent. Syst. 1, 177) must be allowed to have some weight in the determination, and if the name be not applied to some West Indian species resembling one found in Europe, it should be entirely dropped, as tending to confusion.

GROUP XV.

A species of normal form; the head and thorax are very finely granulate, the former is glabrous and finely striate near the eyes; the latter is subcylindrical, convex and slightly rounded on the sides, which are sparingly pilose. Labrum one-toothed, labial palpi pale with the last joint dark; eyes large. Elytra finely serrate, with the tip rounded in both sexes, with a small sutural spine; densely punctured, with a row of unusually large foveæ near the suture: markings interrupted; the medial band from the position of the spots,

which are its relics, appears perpendicularly refracted, the apical lunule is inflexed anteriorly, and between it and the band is a marginal spot, which is sometimes prolonged anteriorly to the medial band. Under surface moderately hairy at the sides, legs long and slender. Anterior tarsi of the male narrowly dilated.

46. C. punctulata, supra fusco-atra, capite thoraceque ænescentibus, hoc latitudine vix breviore, subtilius granulato-rugoso, lateribus rotundatis, albo-pilosis, elytris oblongis ad apicem rotundatis subtiliter serratis, punctis albis sæpe obsoletis (quarum 4 marginalibus duabusque discoidalibus) lunulaque apicali tenui antice inflexa albis, fortius punctatis, foveisque cœruleis serie versus suturam impressis; subtus cyanea lateribus albo-pilosis; labro albo unidentato, palpis maxillaribus nigro-æneis, labialibus pallidis articulo ultimo æneo. Long. ·44—·55.

Oliv. 33, tab. 2, fig. 18: Fabr. Syst. El. 1, 241: Herbst, Käfer, 10, 173; tab. 171, f. 8: Dej. Sp. Gen. 1, 101: Gould, Bost. Journ. Nat. Hist. 1, 54: Lec. Ann. Lyc. Nat. Hist. 4, 182: Say, Trans. Am. Phil. Soc. 1, 420; tab. 13, f. 2.

C. micans Fabr. Ent. Syst. Suppl. 61: Herbst, 10, 180, tab. 172, 2. (var. magis ænescens.)

α. Supra læte viridis, vel cyaneo-viridis, capite thoraceque sæpe obscure cupreo-æneis.

From Maine to Texas, and as far west as Santa Fe: abundant on dry roads, and frequently seen in the streets of our largest cities. The form α is found in Kansas and New Mexico, with the ordinary variety. The punctures are more distant in the vicinity of the row of blue foveæ, wherefore, greasy specimens sometimes appear to have a nearly smooth longitudinal spot on each elytron. It would perhaps be more in accordance with scientific law to replace the name micans to this species, but it is so well known by the later name given by the same author, that it seems more proper not to make the change.

GROUP XVI.

A single species of a dull black colour above, with sericeous surface, but no metallic lustre except in the impressions; the head is glabrous, finely granulate behind, somewhat coarsely striate between the eyes, which are moderate in size; the labrum is yellowish white, rather large, broadly prominent and rounded in the middle, with a small middle tooth. Palpi piceous, with the last joint black: labial palpi of the male pale with the last joint black. Thorax cylindrical, finely alutaceous, not perceptibly granulate, and with only a few very fine rugæ. Elytra oblong, rounded behind and finely serrate, with distinct sutural spine: not deeply but distinctly punctured, with a row of shallow foveæ towards the suture.

Body beneath blackish blue, with fine but not dense white hair toward the sides.

Resembles in many of the characters C. obsoleta, but by the form and sculpture it is plainly allied to C. punctulata.

47. C. corvina nigra, opaca, sericea, fronte striolata, thorace quadrato, cylindrico, vix rugoso, ad latera parce piloso, elytris immaculatis minus profunde cœruleo-punctatis, foveis cœrulescentibus versus suturam serie impressis; subtus nigro-cyanea, lateribus subtilius albo-pilosis. Long. ·48.

Northern Mexico, near the Rio Grande, Lieut. Haldeman. Though not known yet as

an inhabitant of our territory, I do not hesitate to introduce this species into our fauna, believing that its range will be found to extend north of the Rio Grande.

GROUP XVII.

A group containing species of rather flat form, brown metallic colour and sericeous surface, but specially remarkable for having the posterior lunule of the elytra represented by a large submarginal spot, while the terminal part, or lunule proper, is entirely wanting. The eyes are moderate, the head glabrous, finely granulate, striate near the eyes: labrum one-toothed: maxillary palpi green-bronzed; labial of both sexes pale with the last joint bronzed. Thorax quadrate, hardly rounded on the sides, deeply impressed, more flat in the female than in the male, alutaceous, not rugose or granulate. Elytra serrate at tip, broadly rounded, with sutural spine distinct, punctures not deep, subsutural foveæ not very distinct; with three marginal spots, one discoidal and one humeral round spot: beneath metallic blue, pubescent at the sides; abdomen of one species partly red. Two species of this group are known to me, both Mexican, of which one extends its range into Texas.

48. C. decostigma, obscura, fusco-ænea, fronte utrinque striolata, thorace quadrato alutaceo, vix rugoso, lateribus haud rotundatis parce albo-pilosis, elytris punctatis ad apicem serratis, spina suturali parva, macula humerali, tribus submarginalibus, alteraque discoidali inter secundam et postremam versus suturam, omnibus rotundatis albis: subtus cyanea, versus latera albo-pilosa, pleuris cupreis, labro albo unidentato; palpis labialibus sexus utriusque pallidis articulo ultimo æneo. Long. ·5.

Chevr. Col. Mex. 1st cent. fasc. 3.

Fredericksburg, Texas, and Tampico, Mexico, Lieut. Haldeman, Rio Bravo: Dr. Berlandiére. Very closely resembles C. flavopunctata *Chevr.;* but differs by its more dull colour, by the suture not being brilliant cupreous, and the last two joints of the abdomen being bluish black instead of testaceous.

GROUP XVIII.

Moderately elongate species with sericeous surface and red abdomen. The labrum is one-toothed; the labial palpi of both sexes are pale at the base, the maxillary are dark piceous at base. The head is glabrous striate each side. Thorax subquadrate, or subcylindrical, slightly hairy toward the sides. Elytra conjointly rounded at the apex in both sexes, and very obsoletely serrulate, moderately but not deeply punctured, with the normal markings divided into spots; the medial band short, sometimes not interrupted, usually (except in form 3,) in advance of its ordinary position; on the margin behind the medial band, and on the disc just before the apical lunule are additional spots. The legs are moderately long, and the dilated tarsi of the male moderate. The under surface is moderately hairy at the sides of the trunk and abdomen, very sparsely hairy about the thorax. There are three principal forms of which the second is found on rocky hills while the first is maritime. The habits of the third are unknown to me.

1. Thorax subquadrate; colour greenish black. C. hemorrhagica.
2. Thorax subcylindric; anterior spots of elytra large; colour blackish brown.
3. Thorax subcylindric; anterior spots of elytra wanting; colour blue. C. cumatilis.

49. C. hemorrhagica, cyaneo-nigra, sericea, capite thoraceque subtiliter granulatis, illo glabro versus oculos subtilissime striolato, hoc quadrato ad latera parce piloso, elytris haud profunde punctatis postice rotundatis subtiliter serrulatis, gutta humerali, altera sub-marginali antica, fascia oblique flexa ante medium, gutta marginali pone medium lunulaque apicali antice inflexa et cum macula discoidali connexa albidis, his omnibus sæpe obliteratis; subtus virescente-nigra, ad latera parce pilosa, abdomine rufo. Long. ·48—·57.

Mas elytris parallelis.

Femina thorace planiusculo, elytris postice paulo latioribus.

Lec. Ann. Lyc. Nat. Hist. 5, 171. Chaud. Bull. Mosc. 1854.

San Diego, on the open ocean shore, June; abundant. The variety with immaculate elytra is about as numerous as the type: the only intermediate form I have observed is a specimen in which the marginal spots and the terminal lunule are all small, while the middle band and posterior discoidal spot are of the normal size. Baron Chaudoir mentions that "in this species we find the Mexican type C. decostigma *Chevr.* (mexicana *Klug,*) and flavopunctata *Chevr.*, from which it is very distinct; the former also inhabits California."

With this opinion of my learned correspondent, notwithstanding the resemblance in the form of the thorax, I cannot entirely agree. The arrangement of the spots of the elytra proves that the relations are rather with C. rufiventris, Hentzii, &c. than with C. decostigma: C. flavopunctata (which is really C. mexicana *Klug,*) has one character of the present group, in the abdomen being partly red, but to produce a similarity of spots, we must obliterate the terminal lunule, replace the discoidal by a submarginal spot, and destroy the marginal spot behind the oblique medial fascia.

50. C. Hentzii, fusco atra, capite thoraceque vix æneo-variegatis subtiliter granulatis, illo utrinque striolato, hoc parum rugoso subcylindrico, lateribus paulo rotundatis, elytris punctatis, postice rotundatis, subtiliter serrulatis, lunula humerali sæpe interrupta, fascia obliqua ante medium extrorsum cum linea marginali brevi cohærente, macula marginali pone medium, lunulaque apicali antice cum macula discoidali connexa albis; subtus cyaneo-viridis ad latera albo-pilosa, abdomine toto rufo. Long. ·42—·48.

Mas elytris fere parallelis; femina elytris postice paulo latioribus.

Dej. Sp. Gen. 5, 428 (Heutzii:) Lec. Ann. Lyc. Nat. Hist. 4, 182.

C. hæmorrhoidalis || Hentz, Trans. Am. Phil. Soc. 3, 254; tab. 2, fig. 2: Harris, New Engl. Farmer, 7, 91; Gould, Bost. Journ. Nat. Hist. 1, 52; tab. 2, fig. 5.

Massachusetts, Dr. Harris. Precisely similar in form and sculpture to the next two species, and indeed so closely connected with them that the three might properly be considered as races of one species. In this, however, the colour is almost black, the two dots of the humeral lunule are connected at the margin; the middle band reaches the margin and is dilated into a short line, which extends forwards; the marginal spot behind the me-

dial fascia is sometimes connected also with this line; finally, the under surface is blue and green, without any admixture of copper.

51. C. 16-punctata, fusco-ænea, capite thoraceque viridi cupreoque variegatis, elytris cyaneo-punctatis, lunula humerali interrupta, fascia obliqua ante medium extrorsum latiore, at marginem haud attingente, macula marginali pone medium, lunulaque apicali cum macula discoidali sæpe connexa albis, subtus ad latera albo-pilosa, antepectore cyaneo, postpectore pedibusque cupreis, abdomine toto rufo. Long. ·45.

Klug, Jahrb. für Insectenkunde, 32.

C. rubriventris Chevr. Col. Mex. 2nd cent.

New Mexico, collected at Frontera, on the Rio Grande by J. D. Clark, Esq., of the Mexican Boundary Commission: in every respect except colour, and in the form of the medial band of the elytra, which does not extend to the margin, it entirely agrees with C. Hentzii.

52. C. rufiventris, atro-fusca, capite thoraceque æneo-variegatis, elytris cyaneo-punctatis, punctis utrinque sex (sæpe obsoletis) lunulaque apicali tenui albis, subtus ad latera albo-pilosa, antepectore cyaneo, postpectore pedibusque viridi-æneis, abdomine toto rufo. Long. ·4—·45.

Dej. Sp. Gen. 1, 102.

Southern States, Maryland to Alabama, among the Alleghany Mountains. Only differs from the two preceding by the spots of the elytra being very small, and sometimes entirely wanting: the middle band is represented by two spots, the outer one being remote from the margin, and not larger than the inner one.

53. C. cumatilis, viridi-cyanea, capite subtiliter granulato, utrinque striolato, thorace subcylindrico, subtiliter rugoso, ad latera parce piloso, elytris confertim haud profunde cyaneo-punctatis, foveisque versus suturam serie impressis, ad apicem rotundatis serrulatis, spina suturali prominula, puncto humerali, fascia media interrupta oblique flexa marginem haud attingente, macula marginali pone medium, lunula apicali tenui, punctoque postico discoidali albis, (sæpe obliteratis, lunula sola apicali relicta;) subtus cyanea ad latera parce pilosa, abdomine toto rufo. Long. ·43—·46.

Lec. Ann. Lyc. Nat. Hist. 5, 173. (Jan. 1852.)

C. Guexiana Chevr. Mag. et Revue de Zool. 1852, 424.

Shreveport, Louisiana, Mr. Guex: Creek Boundary, Dr. Woodhouse. Usually the middle band and posterior marginal and discoidal spots are represented by extremely small white dots: the apical lunule appears to be always present, but is not inflexed.

GROUP XIX.

A species, above of a shining black colour, almost destitute of metallic lustre. Eyes large and prominent; maxillary palpi piceous, but labial palpi pale at the base in both sexes. Front glabrous with a few striæ each side; labrum large, rounded, hardly toothed. Thorax cylindrical, hardly rugous or granulate. Elytra slightly narrowed in front, very faintly punctured, with a row of shallow foveæ near the suture; apex broadly rounded hardly serrate; the markings are a very narrow apical lunule and one or two dots about

the middle. Body beneath nearly glabrous, pubescent only on the coxæ, and sides of the postpectus and first and second joints of the abdomen; the latter is entirely red. The legs are long, with the tarsi considerably longer than the tibiæ; the anterior tarsi of the male are very slightly dilated.

54. C. abdominalis, atra, subnitida, vix æneo tincta, oculis magnis, capite utrinque parce striolato, thorace subcylindrico fere lævi, elytris convexis obsolete punctatis, foveisque cyaneis parum profundis serie impressis, ad apicem vix serrulatis, gutta submarginali ad medium, altera discoidali pone medium (sæpe obliteratis) lunulaque tenui apicali albis; subtus cyanea, coxis, pleuris abdominisque basi ad latera pilosis, abdomine toto rufo; labro magno albo antice rotundato. Long. ·35—·4.

Fabr. Syst. El. 1, 237: Herbst, Käfer, 10, 202: Dej. Sp. Gen. 1, 140: Lec. Ann. Lyc. Nat. Hist. 4, 183; tab. 14, fig. 13.

Middle and Southern States (New Jersey, North Carolina, Georgia, Alabama;) on sand blackened by fire in pine forests.

GROUP XX.

An elongate species of an opaque greenish fuscous colour above, with little metallic lustre: head glabrous, distinctly granulate, front finely striate, eyes moderate; labrum short, almost truncate, one-toothed; palpi, maxillary piceous with the last joint black bronzed, labial pale, with the last joint also black bronzed. Thorax cylindrical, finely granulate and rugous: elytra rounded at the tip, but not serrate, punctured, with a white submarginal band reaching from the humerus to the tip, and slightly lobed internally, with two teeth representing the middle band and apical lunule. Beneath finely hairy on the sides, abdomen rufo-testaceous at the margin and tip.

55. C. marginipennis, olivaceo-fusca, opaca, capite cyaneo-variegato, antice subtiliter striolato, thorace latitudine longiore subcylindrico, ad latera parce piloso, elytris punctatis, haud serratis spina suturali parva, vitta submarginali integra intus lobata et breviter bidentata alba ornatis; subtus cupreo-ænea, lateribus pilosis, abdomine rufo-testaceo, segmentis primis duobus medio nigris; labro brevi unidentato, palpis articulo ultimo nigro-æneo, maxillaribus piceis, labialibus pallidis. Long. ·46—·53.

Dej. Sp. Gen. 5, 260: Lec. Ann. Lyc. Nat. Hist. 4, 182; tab. 14, fig. 11.

Found on the shores of the Susquehanna River, below the bridge at Harrisburg, Pennsylvania, in the month of June.

GROUP XXI.

Elongate species, sometimes of large size, having the eyes very large and prominent; the labrum is either one-toothed or three-toothed; the middle tooth of the mandibles is conspicuously smaller than the others; the palpi are pale with black tips in the male, and sometimes also in the female. The thorax is more or less rounded on the sides. The elytra are punctured, the markings are either marginal spots, or a broad slightly lobed margin, which is confluent with the edge, at least towards the apex. The apex is some-

what obliquely narrowed, and very finely serrate, the sutural spine is distinct, but in the females known to me the suture is more or less retracted, and the tips are separately rounded. Body beneath densely hairy on the sides, anus testaceous or piceous. Tarsi of the male very slightly dilated.

Of this group are known to me three principal forms, which might almost form distinct groups.

1. Front glabrous, deeply striate; elytra with a marginal spot and apical lunule. C. severa.
2. Front glabrous, finely striate; elytra with broad white margin. C. circumpicta, prætextata.
3. Front densely pubescent; elytra with broad white margin. C. togata.

56. C. severa, olivacea, vel viridi-nigra, subnitida, capite thoraceque fere politis, illo glabro utrinque valde striato, hoc parce rugoso, convexo lateribus rotundato, elytris ad apicem subtilissime serrulatis, antice fortiter, postice obsoletius punctatis, gutta marginali ad medium lunulaque apicali antice inflexa albis; subtus viridi-ænea, lateribus pilosis, ano vel obscuro vel testaceo; labro acute tridentato. Long. ·57—·7.

Mas elytris cylindricis, sutura prominula, palpis pallidis articulo ultimo nigro-æneo.

Femina elytris planiusculis, sutura parum retracta, palpis maxillaribus basi piceis.

La Ferté, Revue Zoologique, 1841, 41.

Texas and New Mexico: the male, although unique, was very liberally given me by Dr. Schaum: the female was found at Tampico by Lieut. Haldeman.

57. C. circumpicta, olivacea sub-nitida, capite vix rugoso-granulato, utrinque subtilius striato, thorace convexo, lateribus valde rotundatis, vix parce rugoso, elytris fortius punctatis, ad apicem subtilissime serrulatis, margine late albo, intus lobato, et ad medium oblique unidentato; subtus obscure viridi-ænea, lateribus pube densa depressa vestitis, abdomine ad apicem nigro-piceo, labro tridentato. Long. ·55.

La Ferté, Revue Zoologique, 1841, 39; 193.

Texas: the only specimen I have seen was a male, which was most kindly sent to me by Prof. Lacordaire.

58. C. prætextata, fusco-ænea, vel cuprea, subtiliter granulata, haud nitida, capite utrinque subtiliter striato, thorace dorso minus convexo, lateribus paulo rotundatis, albo-pilosis, elytris punctatis ad apicem subtilissime serrulatis, margine lato albo intus valde lobato, ad medium ramo brevi obliquo lato emittente albis; subtus viridi-ænea pube densa alba vestita, pectore abdomineque medio glabris, ano testaceo; labro unidentato. Long. ·55.

Lec. Proc. Acad. Nat. Sc. 7, 220.

Mas sutura prominula, palpis pallidis articulo ultimo æneo.

Femina sutura valde retracta, palpis maxillaribus ad basin piceo-testaceis.

Collected by Dr. Thos. H. Webb, of the Mexican Boundary Commission, and probably found in the valley of the Gila.

59. C. togata, fusco-cuprea, granulata, haud nitida, capite thoraceque albo-pubescentibus, hoc lateribus rotundatis, elytris valde punctatis margine latissime albo intus trilobato, ad apicem serrulatis; subtus viridi-ænea, pube densa alba vestita, pectore abdomineque medio glabris, ano testaceo, labro unidentato. Long. ·44.

La Ferté, Revue Zoologique, 1841, 40.

Texas, Dr. Schaum; Tampico, Lieut. Haldeman. The female is unknown to me.

GROUP XXII.

A very slender species, having the eyes very large and prominent, the head densely pubescent; the labrum short, slightly advanced in the middle and hardly perceptibly one-toothed; the palpi pale, with dark tips. The thorax is cylindrical, densely pubescent, with two subglabrous dorsal vittæ. The elytra are white, the suture (slightly dilated in three places) metallic: the apex is obliquely narrowed and slightly sinuate (in the male,) and very finely serrate. The whole under surface is densely clothed with depressed white hair: the legs are extremely long, the tarsi being one half longer than the tibiæ: the claws are very large; the anterior tarsi of the male, though densely hairy beneath, are very slightly dilated. Seems related to group XII., but abundantly distinct.

60. C. gratiosa, valde elongata, æneo-cuprea, capite thoraceque dense niveo-pilosis, hoc elongato, cylindrico vittis duabus dorsalibus subglabris, elytris ad apicem (maris) oblique subsinuatis, subtilissime serrulatis, niveis, vitta suturali breviter triramosa cuprea opaca; subtus virescens undique dense niveo-pubescens, antennis pedibusque longissimis, unguiculis magnis, labro brevi albo medio paulo prominulo, vix obsolete unidentato. Long. ·4.

Guérin, Rev. Zool. 1840, 37.

Pensacola, Florida; the only specimen in his collection was most liberally given me by Dr. Schaum.

GROUP XXIII.

A very small cylindrical species, of bright metallic colour, with red legs. The labrum is moderately large, rounded in front and feebly bisinuate in the middle, with one very small tooth; it thus appears subtridentate: the head is glabrous, densely striate each side: the eyes are large and prominent. The palpi are pale with black tips. The thorax is cylindrical, slightly hairy on the sides. The elytra are strongly punctured, with a white vitta far removed from the margin, and slightly lobed internally, extending from the humerus to the tip, where it bends around to the suture: tip obliquely narrowed (in the male) and slightly serrate. Body beneath hairy on the sides; anus testaceous. Anterior tarsi of the male very slightly dilated.

61. C. lemniscata, elongata, cylindrica, supra fulgente-cuprea, capite thoraceque viridi-variegatis, granulatis et rugosis, illo utrinque fortius striato, hoc cylindrico, utrinque parce piloso, elytris fortiter dense punctatis, cylindricis ad apicem oblique angustatis, subserrulatis, vitta integra alba discoidali intus pone medium bilobata, et ad apicem ad suturam ambiente ornatis: subtus cyaneo-viridis, lateribus usque ad anum testaceum albopilosis, pedibus rufis; labro albo antice rotundato, medio obsolete subtridentato; palpis pallidis articulo ultimo æneo. Long. ·31.

Lec. Proc. Acad. Nat. Sc. 7, 220.

Found by Dr. Webb of the Boundary Commission, and probably from the valley of the Gila.

GROUP XXIV.

Two very small species of dull sericeous surface, without humeral angles. Head large, glabrous, eyes very prominent, front much striate each side. Labrum moderate, rounded

in front, with a prominent medial tooth limited each side by a slight incisure, palpi pale at the base in both sexes. Thorax long, cylindrical, slightly narrowed behind, with faint transverse impressions, sides finely sparsely pubescent. Elytra narrowed in front, humeral angles none; tip rounded, not serrate, sutural spine large, retracted in the female, prominent in the male; coarsely punctured, sparsely clothed with short hair: the markings are a very narrow apical lunule, a discoidal dot and marginal line representing together the medial band, and in one species an anterior discoidal dot, which is the tip of the humeral lunule, or in the other species a very slender imperfect lunule. Wings rudimentary, unfit for flight. Body beneath hairy at the sides, anus testaceous; legs very long, anterior tarsi of the male feebly dilated.

62. C. celeripes, fusco-ænea, obscura, sericea, capite thoraceque granulato-rugosis, illo utrinque fortius striato, oculis maximis, hoc cylindrico, latitudine sesqui longiore, postice subangustato, lateribus rectis parce pilosis, elytris fortiter punctatis, antrorsum angustatis, humeris nullis, ad apicem late rotundatis haud serratis, spina suturali magna, guttis utrinque discoidalibus (ad trientem a basi et apice positis) posteriore interiore, linea marginali ad medium, lunulaque apicali tenui albis; subtus viridi-ænea, lateribus albo-pilosis, trochanteribus anoque testaceis; labro albo antice rotundato, medio bisinuato et unidentato, palpis sexus utriusque ad basin pallidis. Long. ·3—·35.

Mas sutura integra; femina sutura retracta.

Lec. Ann. Lyc. Nat. Hist. 4, 183; tab. 14, fig. 14.

Found near the branches of the Kansas River, and between the latter and the Platte: in the month of May I found it extremely abundant, and a further suite of specimens from Fort Riley I owe to the kindness of Dr. Wm. A. Hammond, U. S. A. Specimens occur in which the discoidal dots are wanting, and only the apical lunule and marginal line remain white; sometimes even the latter disappears.

Nearly allied, but perhaps only a variety, is the species indicated by me (Proc. Acad. Nat. Sc. 6, 66) upon a single elytron brought from the Creek Boundary by Dr. Woodhouse: the punctures are not so large or so deep, the pubescence, if any existed, has been removed by the alcohol in which it was preserved: the humeral lunule is slender, curved, and entire; the marginal line sends off an internal branch at the middle running towards the discoidal spot, and the apical lunule is rectangularly inflexed at its anterior extremity. Among the specimens sent by Dr. Hammond is one, however, which corresponds exactly with the elytron above mentioned: in form it agrees exactly with C. celeripes, and by close inspection a few hairs may yet be perceived on the elytra, the punctures are less deep, and the tibiæ, tarsi, and tip of the femora are testaceous with green metallic lustre. On this account I am induced to separate it as a distinct species.

63. C. cursitans, elongata, æneo-fusca, sericea, elytris modice punctatis subglabris, antrorsum angustatis, lunula humerali antice abbreviata postice inflexa, cum linea marginali iuncta, hoc ramulo ad medium emittente, versus guttam dorsalem tendente, lunulaque apicali tenui antice inflexa albis; subtus viridi-cyanea lateribus albo-pilosis, ano obscuro, trochanteribus, femorum apice, tibiis tarsisque plus minusve testaceis. Long. ·34.

One female, Fort Riley, Dr. Hammond.

SPECIES UNKNOWN TO ME.

I. 'C. decemnotata, green above, tinged with cupreous; elytra margined with bright green or bluish; four white spots and an intermediate refracted band.'

Say, Am. Ent. pl. 18; Journ. Acad. Nat. Sc. 1, 19.

'Labrum three-toothed, white; mandibles black, base white: elytra with a white spot on the shoulder, another equidistant from the first and the band: band broad, arising from the middle of the margin, refracted at the centre of the elytron, and terminated near the suture in a line with the tip of the third spot: this spot is large, orbicular, and placed near the external tip of the terminal one, which is transverse and triangular; body beneath green, trochanters and tail purple.' Length three-fifths of an inch nearly.

Mr. Nuttall; found on the Missouri River above the confluence of the Platte. Seems allied to C. purpurea (race limbalis or amœna) or to C. patruela, but is evidently distinguished from each by the middle band being more deflexed.

II. 'C. limbata, elytra white, suture oblique line and dot green, exterior and basal edge bluish. Length less than half an inch.'

Say, Journ. Acad. Nat. Sc. 1, 141.

'Body green, varied with blue and purple, and with cinereous hair: antennæ black at tip, labrum and exterior and superior base of the mandibles white: thorax hairy each side, indented lines violaceous; elytra white, a green sutural vitta narrowed behind, an oblique irregular line behind the middle, and a small triangular dot before the middle green; exterior edge and basal edge, bluish green or violaceous; beneath hairy; venter purplish. This species, at first sight, resembles C. dorsalis, but is very distinct in its marking and in the form of its thorax. Found on the Nebraska and Arkansas Rivers.'

This species does not seem allied to any that I have seen.

III. 'C. terricola, black; a white line at the tip of the elytra. Length more than two-fifths of an inch.'

Say, Long's Expedition to St. Peter's River, 2, 268.

'Inhabits North West Territory. Body destitute of metallic lustre; labrum white, breadth more than twice the length, tip three-toothed, intermediate tooth conic acute, the lateral teeth angulated obtuse: mandibles white on the exterior base: thorax a little hairy: elytra with scattered very minute punctures, which are oblique, as if formed by a pointed instrument directed towards the anterior part of the insect, so that the surface before each puncture is a little elevated; a white line margins the extremity; venter blackish-testaceous. This species is closely allied to C. pusilla, but the marking of the elytra differs, and the thorax is not so much contracted at base, and is more closely affixed to the abdomen.'

C. triguttata Herbst, Käfer, 10, 182, tab. 172, fig. 5. Unless this is one of the varieties of C. punctulata, it is not North American.

C. obscura Fabr. is the European C. germanica, Erichson, (Käfer Mark Brand. 3.)

C. cœrulea || Herbst, Käfer, 10, 182, tab. 172, fig. 4. (C. Kunzii Gistl.) as stated by Erichson, is also a variety of C. germanica.

C. venosa Kollar, Ann. Wien. Mus. 1, 330, as I am informed by Dr. Schaum is C. nitida Dej.

APPENDIX.

10—11. C. viatica, cyaneo-viridis, fronte utrinque striata medio punctata et pilosa, capite thoraceque subtilius minus dense rugosis, hoc convexo lateribus rotundato, postice paulo angustato, elytris haud profunde punctatis, punctis postice fere obliteratis, puncto humerali strigaque brevi transversa ad medium albis, ad apicem subtiliter serrulatis spina suturali parva: subtus cyanea parce albo-pilosa, labro (feminæ) albo, antice obsolete tridentato. Long. ·46.

Chevr. Col. Mex. 2nd cent. no. 180.

Sonora, Mr. Arthur Schott; one specimen. While these sheets were passing through the press, a valuable collection made by Mr. Schott during his concluding field labours on the Boundary between the United States and Mexico has been submitted to me by the kindness of the Commissioner, Major W. H. Emory: and in it, with many most beautiful species of other genera, occurred the present interesting addition to our fauna.

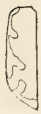
This species resembles in form and colour C. sexguttata, but differs from it by the less densely rugose thorax, the less deeply punctured elytra, and the pilose front. It seems in fact to be most nearly related to the sexguttata group, tending towards the preceding group, in C. rugifrons, from which it is obviously distinguished by the serrate elytra, and less robust form; from both groups it differs by the very slightly marked teeth of the labrum.

This species should therefore form a new group immediately before V. characterized as follows:

Thorax convex, sparsely rugous; front striate, pilose; elytra finely serrulate, not deeply punctured, markings very imperfect.

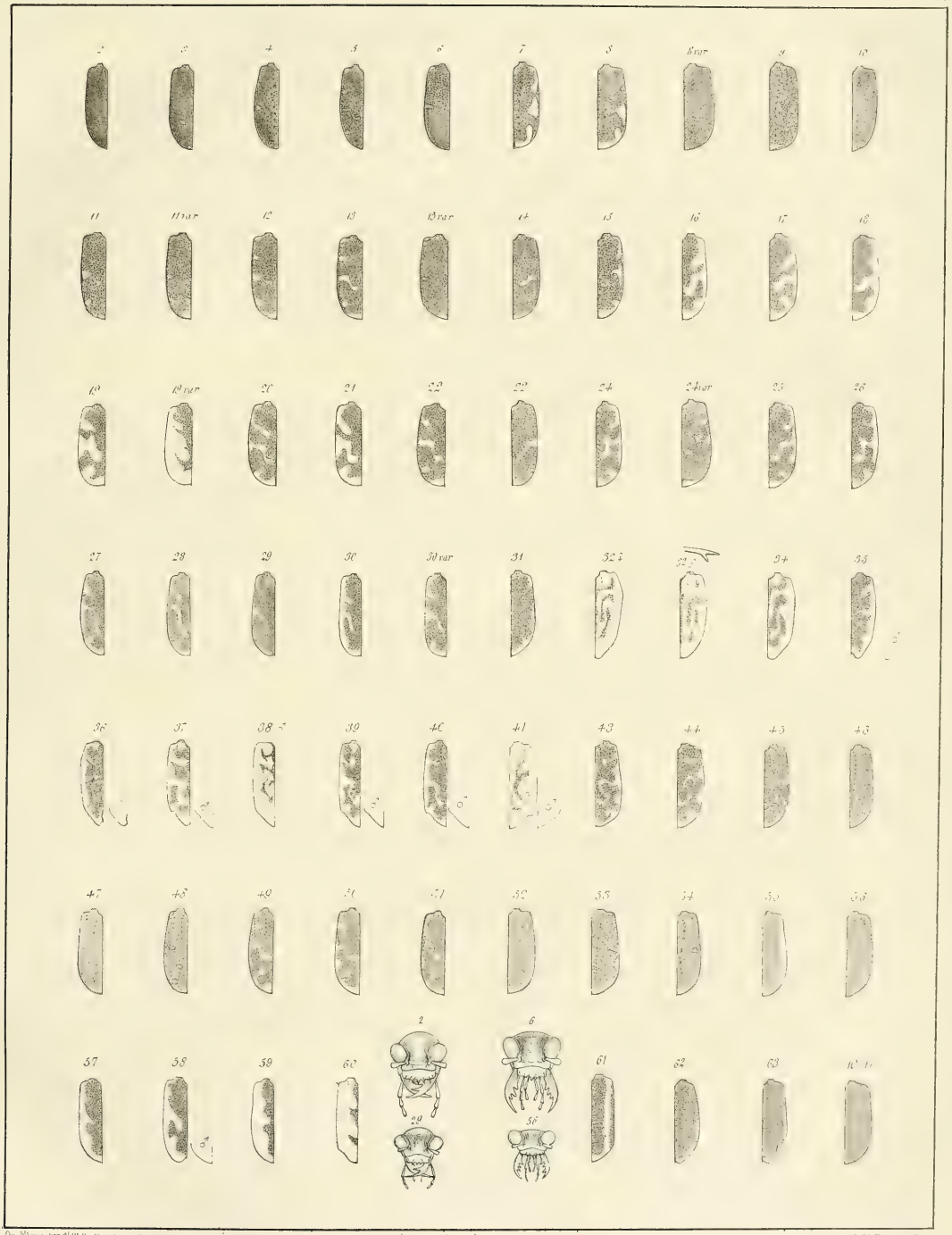
GROUP VI.

On renewed examination, with a very powerful lens, I find that the tips of the elytra of C. splendida and limbalis are not absolutely free from serratures. In the former especially the serration may be perceived in most specimens, but individuals of both species occur in which almost every trace of serration has vanished. In the groups I.—IV., even with the powerful lens, the edge appears perfectly smooth.



27—28. C. californica. By the kind attention of Mr. Ménétriés, I have received, since the printing of the preceding pages, a diagram of an elytron of his species, which I have here reproduced in a wood cut. The markings are quite distinct from any known to me; Mr. Ménétriés informs me in his letter that the labrum has only a single tooth. The species must be placed either in group VIII. or IX.

INDEX OF SPECIES.



On Stone by Wm. E. Hancock

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LECONTE.—CICINDELAE OF THE UNITED STATES

ARTICLE III.

ON A NEW GENUS OF BOIDÆ FROM CUBA.

BY EDW. HALLOWELL, M. D.

[Read April 4, 1856.]

FAM. BOIDÆ. GEN. NOTOPHIS HALLOWELL.

Char. Nostrils opening in a single plate; head covered in its anterior half with symmetrical plates, posteriorly with scales; upper and lower lips *very slightly* pitted; scales of the back and sides carinated; of the lower rows smooth; median row of scales of back and upper part of tail larger than the others, and bicarinated; ventral scutes very narrow; those of tail in a single row; tail short.

NOTOPHIS BI-CARINATUS. NOB.

Char. Colour of a uniform red, lighter upon the cheeks and lips; Abdom. Scut. 204. Subcaud. 40: 26 rows of scales. Total length one foot, six inches, nine lines.

Description. Head small, angular, slightly truncate, depressed, presenting upon its upper and anterior half nine distinct plates exclusive of the supra-orbitar, viz., two internasals, two fronto-nasals, and two pre-frontals; one frontal (vertical,) and two occipital, or post-frontal, with three small plates intercalated between the latter. The rostral plate is more extended in the lateral than vertical direction, somewhat rounded above, excavated in front; the internasal are irregularly quadrangular, in contact in front with the vertical, inferiorly with the nasal, at their inner border with each other, posteriorly with the fronto-nasals; the pre-frontals are two in number, large, more or less quadrilateral, passing down alongside the muzzle in contact inferiorly with the second and third supralabials, posteriorly with the ante-orbitar, and the pre-frontal plates; the pre-frontals are very much smaller than the fronto-nasals, quadrilateral; the frontal (vertical) is regu-

larly pentagonal, much larger than broad; the supra-orbitals are irregularly hexagonal, convex above, not projecting over the eyes; the post-frontals are irregular in shape, a little larger than broad, and have three small plates between them; the nasal plates are quadrilateral, larger than broad, in contact anteriorly with the vertical, posteriorly with the pre-frontals; the nostrils are small, latero-superior, each situated in the nasal plate, nearer its anterior than posterior margin; there is but one ant.-ocular plate, but there are three post-oculars; the former is in contact above and posteriorly with the supra-orbitar, and above with the posterior frontal; the three posterior oculars are of nearly equal size, the superior perhaps a little the largest; the eye rests on the fourth and fifth superior labial plates; the posterior margin of the occipital plate is about a line in advance of the posterior extremity of the gape of the mouth; there are ten superior labials; of these the third and the seventh appear to be the largest; the eye is of moderate size, circular; there are fourteen sublabials exclusive of the mental; the posterior part of the head is covered with scales; the teeth in the upper jaw, constituting the external row, are well developed, sharp-pointed, recurved, their points directed backward, the anterior longer than the posterior; the inner rows of teeth are smaller; the teeth in the lower jaw are also well developed, the anterior ones longer than the posterior; the neck is small, the body more or less cylindrical; the tail short and rounded, tapering gradually to its extremity; the scales are carinated, with the exception of the four inferior rows, which are perfectly smooth; the scales are broad, and more or less quadrangular; 26 rows may be counted at about the middle of the body; the middle row of scales along the back and tail is larger than the others (1 line and ½ in breadth) and distinctly hexagonal, presenting two carinæ in the middle of each scale; the adjacent rows are about a line in breadth, and a line and a half in length; the most inferior row is somewhat larger than either of the lateral rows. The ventral scales are remarkable for their extreme narrowness, being only about 4½ lines in breadth. 204 ventral scuta; 40 subcaudal. The latter single; the præanal scale is also single; the lateral and posterior borders of the anus present a semicircular row of small scales; no spurs evident; colour rufous throughout, without spots.

Dimensions. Length of head 8½ lines; greatest breadth 5½; length of body 16 inches 7 lines (Fr.;) of tail 2½ inches; greatest circumference 2 inches 4 lines.

Habitat. Cuba. Specimen in Acad. N. S. presented by Dr. Gavin Watson.

Gen. Remarks. The Boidæ form the second tribe of the Aproterodonts of Duméril and Bibron, in their arrangement constituting the second sub-family of Pythonians, which belong to the second section of the Ophidians, the Azemiophides, or non-venomous circuiform Serpents. The family of Pythonians are divided into two sub-families, viz., the Holodonts

and the one above mentioned, the first being provided with intermaxillary teeth, the second being without them. The first sub-family is divided into four genera, the second into ten, the first or that of the Holodonts, including the Pythonidæ, having a prehensile tail, the second or the Aproterodonts, the Erycidæ, and the Boidæ, the latter comprising ten genera, having a prehensile tail, the former (Eryx) without. The genera are based upon the presence or absence of fossettes in one or both lips, the disposition of the plates and scales upon the head, their presence or absence, the position of the nostrils, the smoothness or carination of the scales of the body, &c.

The animal above described belongs to the second of the sub-families indicated, or the Aproterodonts, being without intermaxillary teeth. None of the ten genera into which this family is divided presents characters identical with those of Notophis. Platygaster is distinguished by the carination of its scales from "Boa, Pelophilus, Eunectes, Xiphosoma, Epicrates, and Chilobothrus," in all of which the scales are smooth, "besides in presenting a cephalic covering, composed exclusively of symmetrical plates, and not in part of these and in part of scales, or only the latter, as the Leptoboas, and the Enygres," (See Dum. and Bib., Vol. vi. p. 496.) The tail is long and robust. Epicrates has the upper part of the head covered with plates in its anterior and with scales in its posterior half, but the nostrils open between three plates, and the scales of the body are smooth. Epicrates and Xiphosoma are the only genera of their tribe, according to Duméril and Bibron, which have fossettes to the lips. There are two species of Epicrates, E. Cenchris, ten feet long, and E. angulifer longer, the latter from Cuba. The first of these species has a row of scales along the middle of the back, larger than the others. Leptoboa has the head covered with plates in front, and with scales posteriorly, but the interspace between the eyes is occupied with scales, and the tail is long. (127 subcaudal scuta.)

Tropidophis, a Cuban genus, has the head covered with symmetrical plates, the nostril opening between two plates, the scales uni-carinate, the central row not larger than the others; the number of the abdominal and subcaudal plates is nearly the same—147 to 200 abdominal,—27 to 39 subcaudal.

From the genera above mentioned Notophis differs in its small size, having more the general appearance of an Eryx, in the shape of the head, in the mode of carination of the scales, its short tail, the narrowness of the ventral scutes and the position of the nostril, which opens near the middle of a single plate, resembling in this respect Platygaster, but in that genus, the ventral plates are very broad, the tail long, the head covered entirely with plates, and is without fossettes to the lips. Its habitat also is very different. We have carefully examined the works of Duméril and Bibron, and Mr. Gray, the latest authorities in Herpetology, and do not find any animal the description of which corresponds to the

above very remarkable serpent. Nor is it mentioned in the splendid work of De la Sagra on the Natural History of Cuba. It has been for several years in the collection of the Academy of Natural Sciences of Philada. Its proper place would appear to be along side of Tropidophis and Platygaster. It is a very harmless-looking animal. Nothing is known of its habits, which probably resemble those of Tortrix and Eryx.

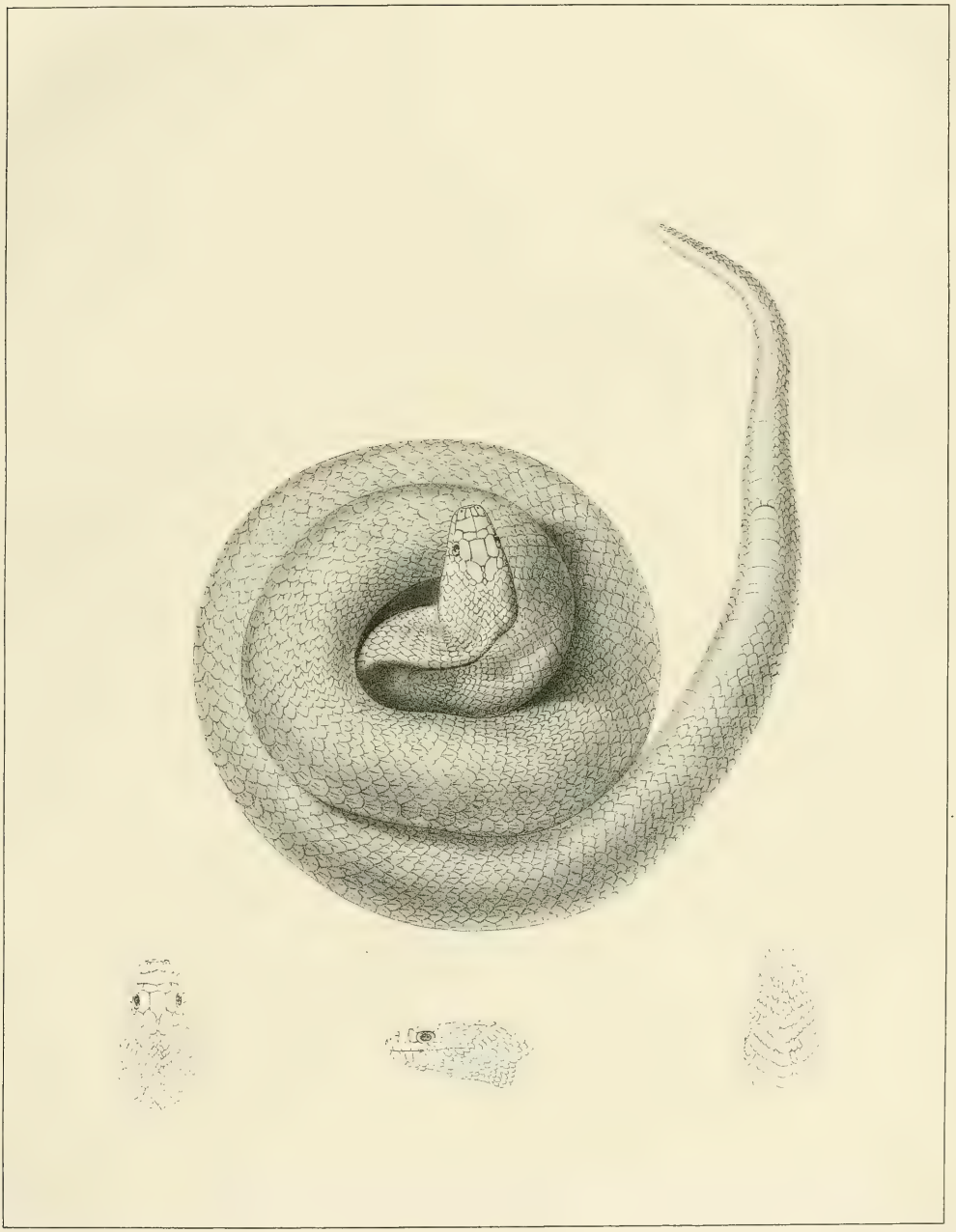
Geographical Distribution. The family of Pythonians, comprising the genera Python, Boa, Eryx, Xiphosoma, Liasis, and others, is represented, say Duméril and Bibron, in the four quarters of the globe, as well as in Australia and the Indian Archipelago. The greater number of species, however, belonging to six genera, viz., Tropidophis (2,) Boa (4,) Eunectes or Anaconda (1,) Xiphosoma (2,) Epicrates (2,) and Chilobothrus (1,) are natives of the American continent, or of the Indian Islands (Tropidophis and Epicrates Cuba.) (Chilobothrus, Jamaica and Porto Rico.) Boa, (divinoloqua, St. Lucia) (imperator Mexico,) (eques Peru.) (Constrictor, N. & E. parts of South America.) (Guiana, Brazil, Rio de la Plata, Buenos Ayres.) A species of Xiphosoma and Pelophilus are found in Madagascar. Eryx according to Duméril and Bibron is found in Europe, Asia, and Africa. Morelia, Nardoa, and Platygaster belong exclusively to Australasia. Python to Africa, Asia and the Asiatic islands. (5 sp.) Liasis to the Asiatic islands and Australia. Platygaster belongs to New Holland, Engyrus to New Guinea and the Moluccas, Leptoboa, to islands dependent upon Africa; Tropidophis, Boa, Eunectes, Epicrates, and Chilobothrus are American. Pelophilus is peculiar to Africa. (Madagascar.)

The total number of Pythonians, according to the celebrated authors above quoted is 33, of which one is common to Europe, Asia, and Africa (Eryx jaculus*) 7 to Africa, 2 to Asia, 2 to Asia and the Asiatic islands, 8 to Oceanica, 12 to America, and one of unknown origin. Above one-third of the species, therefore, exist in America. (See Dum. and Bib., vol. ii. p. 378 and 380.)

Duméril and Bibron remark, as a fact worthy of note, that none of the twelve American Pythonians belong to the sub-family of Holodonts, or those with intermaxillary

* Prof. Schlegel adds Turcomania. None of the species enumerated by Prof. Schlegel in his monograph of the genus Eryx is said by him to inhabit Europe. He divides the Erycidæ into two groups, 1st, those which have the head covered in great part with scales, the nostrils opening between three plates, and the tail short, including, E. jaculus, thebaicus, conicus, and Johnii (maculatus nob.) and 2nd, those which have the head covered with plates, except the occiput, the cheeks, and the throat, the nostrils opening in the middle of a *single* plate, tail short or of medium length, including E. Reinhardtii, and E. multicarinatus, or Platygaster multicarinatus, Dum. and Bib. Tortrix Pseudo-Eryx. Schlegel. Abbildungen, pl. 34. According to Dum. and Bib., the nostrils in Eryx invariably open between three plates. The scales in Platygaster are tricarinate.

Description d'une nouvelle espece du genre Eryx, Eryx Reinhardtii par H. Schlegel, memoir accompagnée d'une planche en noir, 4to.



Drawn on Stone by Wm E. Hitchcock. Lith. Print. & Col. by J. Sidney, Phila.

NOTOPHIS BI CARINATUS.

or incisive teeth, but to the sub-family of Aproterodonts, species of which however exist in Europe, Asia, Africa and Oceanica. The only American genus not exclusively such is Xiphosoma, a species of which (X. Madagascariense) is found in Madagascar. There are according to Duméril and Bibron but 11 species of Holodonts. These are distributed in Australia; in S. & W. Africa (Python Natalensis, sebæ and regius, bivittatus Kuhl,) in Asia and Oceanica (India and Sunda Islands, Python Molurus and reticulatus,) (Morelia argus Tasmania and New Holland,) in which also is found Liasis olivaceus, (Timor, L. Macklotii,) Moluccas and New Ireland (L. amythestinus and Nardoa Schlegelii.) All the species of Pythonians appear to be inhabitants of warm climates, and many of them attain to a very large size, the Anaconda or Eunectes murinus, a water serpent, being from 20 to 30 feet in length, the largest of the serpents known. Others are of much smaller size, the Boa constrictor being only from 9 to 12 feet in length, and Xiphosoma caninum, one of the most beautiful of the serpents, but six. Platygaster is not more than two feet and a quarter in length.

Python Sebæ, or bivittatus Kuhl (Liberiensis nob.) is said by Schlegel to be the largest serpent of the ancient world, being above 20 feet in length. The other Pythons are from 6 to 14 feet long. The Python Sebæ, according to Bosman, is worshipped by the negroes of Guinea, as their chief divinity, and the choice of a new king cannot be made unless sanctioned by the presence of one of these reptiles. According to Schlegel, it was this serpent which the soldiers of Regulus encountered near the Bragada, the size of which however is greatly exaggerated by Pliny. (Essai sur la Physiognomie des Serpens, Tome 11, p. 410.)

ARTICLE IV.

NOTICE OF SOME NEW AND RARE SPECIES OF SCINCIDÆ IN THE COLLECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

BY EDWARD HALLOWELL, M. D.

[Read, June 20, 1856.]

The family of Scincidæ or Lepido Saurians of Duméril and Bibron occupy a position in their arrangement intermediate between the Chalcidians, including the genera Zonurus, Gerrhosaurus, Gerrhonotus, Pseudopus, Ophisaurus, Pantodactylus, Ecpleopus, Chamæsaurus, Heterodactylus, Chalcis, Chirotes, Amphisbæna, Lepidosternon, and the Ophidians, or serpents, to which they pass as observed by them through the genera Anguis, and Acontias, which most nearly resembles the latter.

The following are the characteristics of the family as laid down by Dum. and Bibron, vol. v., p. 513 of their Erpétologie genérale.

1st. Head covered above with horny slender angular plates, united in a regular manner.

2nd. Neck of same form and thickness as the chest.

3rd. The rest of the trunk and members furnished on all sides with imbricated scales, having several margins, for the most part broad, and with the free edge slightly rounded, disposed in quincunx; back rounded, without crests, or erect spines; belly cylindrical, without a lateral groove.

4th. Tongue free, flattened, without a sheath, slightly notched in front, its surface covered in whole or in part with papillæ; most usually all in the form of scales; it occasionally happens that some are squamiform, and others filiform.

These characters readily distinguish the Scincks from the Lacertians proper, which have for the most part quadrangular scales upon the abdomen, placed in longitudinal rows, differing from those upon the rest of the body, and of the rest of the other Saurians.

The family of Scincidæ is divided by Duméril and Bibron into three sub-families,—viz. 1st. Scincidæ Sauropthalmidæ, having eyes resembling those of the greater part of the lizards, provided with two moveable eyelids closing the eye completely. 2nd, Scincidæ Ophiopthalmidæ, the eyes in which have only rudiments of lids, being uncovered, as in the serpents; the lids sometimes however forming a slight fold at the upper part of the orbit; 3rd, Typhlopthalmidæ, in which the eyes are covered by the skin, as in Typhlops and Amphisbœna. These sub-families are divided into thirty-one genera.

The first sub-family, or the Sauropthalmidæ, is arranged in two groups, the first having extremities, with a variable number of fingers and toes, the second without extremities.

Of the species belonging to the first, some have four, others but two extremities. There are eight genera to the first division. The tetrapod genera have either five toes to each extremity or less than five. The genera which have four toes in front, and posteriorly, are the Tetradactyles, but in Heteropus there are five behind, and in Champso-dactylus there are, as in the Crocodiles, four in front and five behind. In Nessia, Hemiurgis and Seps there are but three in front and three posteriorly. Four other genera have less than three, thus in Chelomeles, there are two in front, and two behind, but in Brachymeles, the posterior extremities have but one finger only. In Brachystopus there is but one in front, and two behind, and in Evesia there is but one in front and one posteriorly.

Of the Sauropthalmidæ, which have only posterior extremities, Scelotes has but two toes; but Prepedites, and Ophiodes have no toes whatever. Lastly, in the great division of Scincoids with two moveable eyelids and without members, there are three genera, which were formerly ranked with the serpents, viz. Acontias, Anguis and Ophiomorus, in the second of which the nostril opens in a single plate, and in the last between two; the first being distinguished by having a large plate, enclosing like a case or tube, the whole of the muzzle. None of the Sauropthalmidæ have pores under the thighs, or upon the anterior margin of the cloaca; the toes are smooth below and without lateral denticulations, except in Scincus officinalis, the only species of Scincus, and the only instance which presents them among all the Scincidæ. The second sub-family, or that of the Ophiopthalmidæ, are divided like the first into two groups according to the number of extremities. These genera have four, and others only two behind. In the tetrapod species, Lerista has two fingers, to the anterior extremities, three to the posterior; Ablepharus has five fingers, and five toes, and Gymnopthalmus but four of the former, and five of the latter. The Scincoid Ophiopthalmidæ which have only two posterior feet are divided into two genera, the 1st Hysteropus, has the extremities simple, or not divided into toes, but flattened, and ramiform. In the second genus, or Liasis, these extremities are merely pointed filaments. The Typhlopthalmidæ include but two genera. 1st, Typhlinus, which

has no feet at all, and Dibamus which presents two short and flat appendices not divided into toes corresponding to the posterior extremities.

Geographical Distribution. "The Scincks are distributed upon almost the whole surface of the globe, in cold as well as in the warmest climates. More species are found in Oceanica and New Holland than elsewhere, but the other families of Saurians are much less numerous there than in other parts of the world. There is no genus of Scincidæ peculiar to Europe. The genera Scincus, Sphenops, Amphiglossus, Liolepisma, Brachystopus, Scelotes, Acontias, Typhlinus are peculiar to Africa, and Tropidophorus, Champsodactylus, Brachymeles to Asia. Diploglossus, Ophiodes, Gymnopthalmus are exclusively American, and Tropidolepisma, Cyclodus, Trachysaurus, Heteropus, Tetradactylus, Hemiergis, Chelomeles, Nessia, Evesia, Prepedites, Hysteropus, Liasis, Lerista, and Dibamus, belong exclusively to Polynesia. Euprepis is stated by Duméril and Bibron to be common to Africa, Asia, America and Australia, and Eumeces to Asia, America, Australia, Polynesia; Plestiodon to Africa, Asia and America, Lygosoma to Asia, America, and Polynesia, Seps, and Anguis to Europe and Africa, and Ablepharus, to Europe, Africa, Asia, Australia, America and Polynesia." (See Duméril and Bibron, Erpétologie générale, vol. v., pp. 545, 546, 547.) The entire number of species of Scincoid, or Lepidosaurian Lizards, is 100. Of these we have at present in the Academy of Natural Sciences but forty species, or one hundred and thirty-two individuals belonging to fifteen genera, being not quite one-half of the whole number; but we hope, through the zeal of our members and exchanges abroad, that ere long the number will be greatly increased, if not be made complete.

The Scincoid reptiles described in the following paper belong to the sub-genera Plestiodon, Eumeces, Euprepis, and Ablepharus. The first and third are provided with pterygoid teeth, the nostrils in all, opening in a single plate, which is not the case either in Scincus, or Gongylus, in the former between two, viz. the nasal, and the anterior supero-nasal, in the latter between the nasal and the rostral. Plestiodon, Eumeces and Euprepis have supero-nasals; Ablepharus is without them, which is also the case in other genera, as Tropidolepisma, Trachysaurus, and Cyclodus.

SUB. GEN. EUMECES WIEGMANN.

Char. "Nostrils opening in a single plate, the nasal, near its posterior border; two supero-nasals; palate without teeth, with a triangular notch, not deep, situated posteriorly; scales smooth, D. & B., 12 sp.

Eumeces quadrilineatus. Hallowell. Proceed. A. N. S., vol. vii. p. 95, two specimens, one adult, and one young from Astoria, Columbia river, presented by Dr. Townsend. They

differ from E. Spixii in the greater breadth of the scales, there being but twenty-four rows, and the broader white lateral band on each side occupying the half of each of the two adjoining rows of scales.

SUB-GEN. EUPREPIS WAGLER.

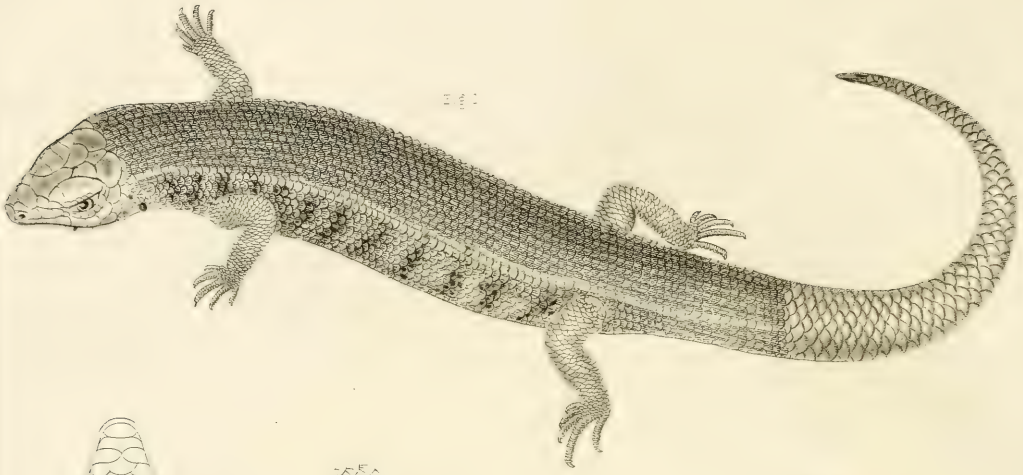
Char. Nostrils in the posterior border of the nasal plate; two supero-nasals; palate with a triangular notch, more or less deep; pterygoid teeth; scales carinated.

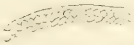
Euprepis striata,* nob. Syn. Euprepis striata. Proceed. A. N. S., vol. vii. p. 98.

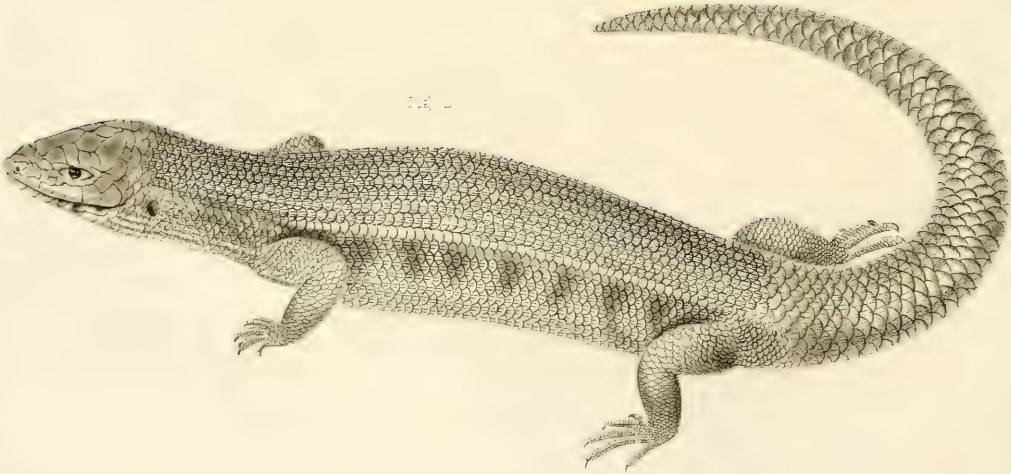
Char. Lower eyelid scaly; colour blackish above, tinged with brown; scales upon back and tail, white spotted; back presenting alternate lines of black and white spots; body robust, 33 rows of scales, tricarinate upon back and sides.

Description. Nostrils in the posterior part of nasal plate, which is large; supero-nasals large, contiguous, much broader in front; inter-nasal much broader than long, its inferior and lateral margin in contact with the anterior frenal; two fronto-nasals; a frontal, long, much broader anteriorly, where it presents three fronts, in contact with the inter-nasal and fronto-nasals; two fronto-parietals much larger than the fronto-nasals; an inter-parietal; two large parietals; no occipitals, or scales larger than the rest behind the parietals; a rather large freno-nasal; two frenals, the anterior, more narrow and higher than the posterior; two freno-orbitar, the first much larger than the latter, and more or less quadrilateral in shape; there are seven supra-labials; the fourth or fifth, as the case may be, is larger than the rest, and oblong quadrilateral; four large supra-ciliary scales; auricular openings circular, with three small scales in front; the lower eyelids covered with scales; tongue narrow in front, not notched anteriorly, broad behind, where it presents a deep notch; covered with scales; smaller in-front, larger behind; palate notched posteriorly, not furrowed; no pterygoid or palatine teeth; teeth notched longitudinally; 44 in the upper jaw in the specimen examined, more or less quadrangular in shape, 32 in the lower; the anterior teeth in the lower jaw somewhat longer than those which immediately follow; body robust; 33 rows of scales; those upon the back and sides five carinated, the middle, and two lateral carinæ shorter and more narrow than the others; scales upon upper and lateral parts of tail and extremities carinated; posterior margin of scales upon back and sides tridentate, the denticulations corresponding to the posterior extremities of the three middle carinæ; scales of abdomen smooth, more or less rounded posteriorly, very finely striated, the two middle, the most distinct; third and fourth finger about equal length; second toe longer than the first; first toe much larger than the fifth; six or seven præanal scales;

* From the alternate lines of black and white along the back.







ground colour blackish above, with a tinge of brown; each scale upon upper and lateral parts of body and tail, spotted with white; the back presenting alternate lines of black, and white spots; the white colour predominant upon the sides; under surface white; sides of neck and throat presenting three or four dark-coloured irregular longitudinal lines.

Dimensions. Length of head, one inch, one line; greatest breadth, nine and a half; length of body to vent, three inches, ten lines; length of tail, four and a half inches; (Fr.) Total length, nine inches, five lines.

Habitat. Gaboon country. Specimen in the Museum of the Academy of Nat. Sciences, presented by Dr. Henry A. Ford. Nothing is known of its habits.

Gen. Remarks. The former description in the Proceed. Acad. Nat. Sciences, is wanting in precision, and contains several errors. The country it inhabits, I am informed, is about 900 miles south of Liberia.

EUPREPIS HARLANI. NOB.

Syn. Plestiodon Harlani. Proceed. A. N. S., vol. 11, p. 175.

Char. Lower eyelid scaly; colour, Indian yellow above; nine or ten transverse bands of dark brown upon the sides; the interspaces white mingled with yellow; thirty-one rows of scales, tricarinate upon back and sides; body stout.

Description. Nostrils large in posterior part of nasal plate; two supero-nasals, quite large, contiguous, much broader anteriorly; internasal large, broader than long, its inferior margin in contact with the first frenal; two fronto-nasals, one line apart; a long frontal, much broader anteriorly, presenting three plane surfaces, where it is in contact with the inter-nasal, and the two fronto-nasals; two fronto-parietals, about twice as large as the fronto-nasals; an inter-parietal, broad in the middle, quite narrow at the extremities; two large parietals, no occipitals; a row of larger scales than those upon the back behind the orbit and parietal plates; a freno-nasal more extended inferiorly than above; two frenals, the anterior higher and more extended than the posterior; two freno-orbitars; the first quadrangular, and larger than the second; five supra-ciliary scales; lower eyelid scaly; seven superior labials, the last the largest; auricular opening circular; body quite stout, more or less quadrangular in shape, with thirty-one rows of hexagonal scales, the posterior margin slightly denticulate, each scale upon back and sides, with three distinct carinæ, the lateral carinæ the largest; sometimes but rarely four carinæ may be observed; scales upon upper part of sides of tail distinctly tri-carinate; scales of abdomen and under part of tail smooth; seven præanal scales; tail round, cyclo-tetragonal at base, tapering gradually to a point, third and fourth fingers of about equal length; second toe, a little longer than the third; colour, Indian yellow above, the margin of the scale of a

darker colour; sides of neck and under jaw, dark brown with white spots upon the latter, arranged upon the inferior parts of it in short rows, looking like Mosaic. Nine or ten transverse bands of dark brown upon the sides, extending from the back to the abdomen, with intermediate spaces of white; sides of tail, brown, spotted with white; under surface of body, tail and extremities, straw-coloured, with longitudinal, zigzag lines of a darker shade, along the external border of the scales; the longitudinal lines are broader, and of a dark brown colour, upon the chin and throat; transverse bands of brown upon the under part of the lower jaw or each side anteriorly.

Dimensions. Length of head, fourteen lines; greatest breadth, nine lines; length of neck and body to vent, four inches; of tail four inches, eight lines. Total length, nine inches, ten lines.

Habitat. Liberia, West coast of Africa, one specimen in Mus. Acad. Nat. Sciences, presented by J. J. Haldeman, Esq.

EUPREPIS BLANDIGII. NOB.

Syn. Euprepis Blandigii, Hallowell, Proceed. Acad. Nat. Sciences, vol. ii. p. 58.

Char. Lower eyelid with a transparent disk. A broad, lateral black band, margined with two white vittæ; ground colour above olive, with four narrow black lines along the back; under parts silvery white; twenty-nine rows of scales, tri-carinate upon back and sides; body slender.

Description. The head is of moderate size, triangular, narrow, flattened above; the snout is somewhat prolonged and rounded in front; the plates upon the upper surface of the head, as well as those upon the sides, are perfectly smooth; the rostral plate is large, pentagonal, presenting an obtuse angle at its summit; the nasal plates are of moderate size, triangular, rounded posteriorly; the supero-nasals are narrow, oblong, in contact with each other; the inter-nasal plate is larger, presenting the form of a lozenge with its lateral angles truncated, the posterior angle acute, the anterior obtuse; it is in contact in front with the two supero-nasal plates, its anterior angle not reaching quite so far as the rostral; the fronto-nasals are of moderate size, sub-pentagonal; their lateral and inferior margins are in contact with the superior margin of the two frenal plates; the freno-nasal is small, triangular; the first of the frenal plates is oblong, quadrilateral; the second, which is much the larger of the two, is pentagonal; the frontal plate is also pentagonal, much broader in front, rounded posteriorly; the fronto-parietal are oblong pentagonal; their anterior margins, or those which embrace the posterior margins of the frontal, are the smallest; they are in contact, laterally, with the two supra-orbitar, and posteriorly with the parietal and inter-parietal plates; the parietals are large, pentagonal; the inter-paric-

tal is smaller than either of the fronto-parietals, and terminates posteriorly in an obtuse point; there are four supra-orbitar, and two freno-orbitars; the exterior margin of the supra-orbitar is bordered by a row of seven small oblong quadrangular plates; immediately behind them is a small rhomboidal plate, the upper half of which is received between the posterior supra-orbitar and the parietal; there is no occipital, but immediately behind the parietal are two oblong scales, much larger than the rest, presenting numerous striæ or elevated lines upon their posterior margin; the labial plates are seven in number; of these the fifth is most remarkable; it is regularly quadrilateral, oblong and much larger than either of the others, forming, of itself, one-half of the inferior margin of the orbit; the second, third, and fourth are rhomboidal; the first is irregularly quadrilateral, the sixth and seventh are pentagonal; lower eyelid with a transparent disk; the ear is of moderate size; its inferior margin is bordered with numerous small granules, and there are two or three small scales in front; the scales upon the body are hexagonal, more or less rounded posteriorly; 29 rows; those upon the back, sides and tail present three carinæ upon their surface, all of which are very distinct; about five lines from the posterior extremities, upon the back of the tail, is a row of scales broader than the rest, extending as far as its extremity, with five, six, and even seven carinæ: these broader scales are seen in all the specimens examined. There are eight scales immediately in front of the anus, of nearly equal size.

Colour. A broad black band, commencing behind the orbit and passing along the side of the body, as far as the posterior extremities, becomes lost upon the tail; below this is a white, narrow vitta, beginning near the anterior extremity of the orbit, and terminating near the posterior extremity of the body; upper margin of black lateral band margined with a more narrow and interrupted vitta, commencing at the occiput and extending the whole length of the trunk; four black lines, two on each side, along the back; ground colour above, olive or brown; under parts silvery white.

Dimensions. Length of head seven lines; greatest breadth posteriorly, 3½; length of body, 1 inch 9 lines; length of tail 4 inches.

Habitat. Liberia, W. Africa. 5 specimens in Mus. Acad., N. S. Two from the Gaboon Country, presented by M. Duchaillu; two adult and young from Liberia, by Dr. Blanding, and one, name and locality not mentioned.

Gen. Remarks. This species differs from any of those described by Duméril and Bibron.

EUPREPIS LONGICAUDATA. NOB.

Char. Lower eyelid scaly with a transparent disk; colour olive-green above; white, with a tinge of green below; posterior half of tail brown; a broad, black, lateral band

upon each side of the trunk; 30 rows of scales; bicarinate upon back and sides; body slender; tail very long.

Description. Nostrils in a single plate, near its posterior border; two slender supero-nasals apparently contiguous; a large inter-nasal extending laterally upon the sides of the head, where it joins the supero-nasal and the first frenal plate; two fronto-nasals, not in contact, more or less quadrangular, each passing likewise down upon the side of the head, where it joins the first and second frenal; a frontal much longer than broad, narrower behind, presenting an acute angle in front; two fronto-parietals, pentangular; one inter-parietal; more narrow posteriorly, and two parietals, larger than the fronto-parietals; no occipital; a small naso-frenal; two frenals, the posterior the larger, and more elongate; two freno-orbitars; seven superior labials; the fifth the largest, and more or less quadrilateral; a transparent disk to the inferior eyelid; body slender with thirty rows of scales; those upon the abdomen and sides rounded posteriorly, those of the back more distinctly hexagonal; scales upon the back distinctly bi-carinate; those upon the sides also bi-carinate, but the carinæ are very indistinct; scales upon the back smooth, as well as the inferior rows upon the sides; scales of the tail tri-carinate above; smooth, laterally and inferiorly; seven præanal scales; tail very long.

Colour. Olive green above, white with a tinge of green below, except upon posterior half of tail; which, as well as the upper part, is brown; a broad black lateral band on each side extending from behind the eye, passing over the ear, and terminating at the base of the tail; it occupies two rows of scales and the greater part of each of the adjoining rows.

Dimensions. Length of head, seven lines; greatest breadth six lines; length of body to vent, two inches, four lines; circumference, one inch, three and a half lines; length of tail, five inches, nine and a half lines, (a portion broken off,) total length, eight inches, four and a half lines.

Habitat. Siam. One specimen presented by Dr. Ruschenberger. Nothing especial is known of its habits.

EUPREPIS DISSIMILIS. NOB.

Char. Lower eyelid with a transparent disk; colour light olive above, with three lighter-coloured vittæ; two more narrow vittæ upon the scales; in some specimens, spaces between the vittæ, brown spotted; sides spotted with white; thirty-three rows of scales; lateral rows tri-carinate; intermediate ones smoothly bicarinate; body short.

Description. Nostrils in a single plate, near its posterior border; two supero-nasals, slender, contiguous, an inter-nasal, broader than long; two fronto-nasals in contact; a

frontal much more narrow posteriorly, separated from the inter-nasal by the fronto-nasals; two fronto-parietals, longer and more narrow than the fronto-nasals; a short inter-parietal, broad in front; two parietals considerably larger than either the fronto-nasals, or fronto-parietals; a small naso-frenal; two frenals, the posterior the larger, and two freno-orbitar, the posterior the smaller of the two; seven superior labials, the fifth long and quadrilateral; a transparent disk in the lower eyelid; meatus auditorius furnished with three small scales in front; body moderately robust, with thirty-three rows of carinated scales, the seven lateral rows more or less *tricarinate*, the intermediate rows strongly *bi-carinate:* scales distinctly hexagonal; tail long and tapering, cyclo-tetragonal at base; scales of the tail upon sides, tri-carinate; bi-carinate above.

Colour. Light olive above, with three distinct lighter coloured vittæ, commencing behind the occiput, and extending along the back, and upon the tail; two narrow vittæ, one on each side, inferiorly; under parts white, without spots; in another specimen the back and sides are also spotted with brown, and there is a double row of white spots on each side.

Dimensions. Length of head, nine lines; greatest breadth, five; length of body to vent, two inches and a half: (Fr.) length of tail, four inches and eight lines; total length, seven inches and eleven lines; circumference, one inch and eleven lines.

Habitat. Bengal. Two specimens presented by Dr. Burroughs.

Gen. Remarks. This is a beautiful species of Euprepis; remarkable for the gracefulness of its form and colouring, and the mode of carination of its scales, which appears to be unique, none of the species described by Duméril and Bibron, presenting a similar arrangement. It resembles in colouring the Tiliqua trivittata of Mr. Gray. See Hardwicke's Illustrations of Indian Zoology, and Zoological Journal, Lond. vol. 3, p. 227, but the tail is represented as shorter, and no mention is made of the inferior lateral stripe: nothing is said of the carination of the scales.

EUPREPIS MICROCEPHALUS. NOB.

Syn. Scincus ventralis, Peale and Green.

Char. Lower eyelid scaly. Ash-coloured above, with five, longitudinal dark-coloured lines along the back; twenty-nine rows of scales; 7—8 carinated upon back and sides; body short.

Description. Nostrils in a single plate, near its posterior border; two supero-nasals, not contiguous; an inter-nasal, broader than long, its lateral and inferior margin in contact with the first frenal; two fronto-nasals; a frontal very large, broader anteriorly; a small interparietal; two parietals broad, and rather short; immediately behind them two broad

and narrow scales; six supra-labial plates, the fourth much larger than the rest, and quadrilateral, head short, trapu; gape of mouth small; tongue slightly notched in front, papillous; auditory opening somewhat triangular in shape, with three small scales in front; body slender, surrounded with twenty-nine rows of scales; those upon back and sides, with from seven to eight carinæ, the middle ones wider apart than the others; scales upon upper part of tail, 7–8 carinated, those beneath smooth, tail longer than head, neck and body, cyclo-tetragonal at base, tapering gradually to a point. Colour in spirits, uniform ash, with traces of four longitudinal narrow dark-coloured lines, extending the whole length of the trunk.

Dimensions.—Length of head 5½ lines, greatest breadth, 3½. Length of neck and body to vent, 1 inch 7½ lines; length of tail, 2 inches, 9 lines.

Habitat.—Mexico. One specimen in Mus. Acad., N. S., presented by Mr. W. H. Keating.

Gen. Remarks.—This is a very singular tropical animal, its physiognomy and general appearance are quite peculiar. Its short head, thick neck, ramassé body, and rather long tail, give it an air of oddity, not usual among the Scincidæ.

EUPREPIS SURINAMENSIS.

Character.—Lower eyelid with a transparent disk; colour olive, above with brown spots, arranged sometimes into two longitudinal rows; a brown band on each side; 30 rows of scales, tricarinated upon back, smooth upon the sides; carinæ not very distinct; body robust.

Description.—Nostrils in a single plate, near its posterior border; two supero-nasals contiguous, broader in front; a large and broad inter-nasal, its lateral and inferior margin in contact with the first frenal; two fronto-nasals not contiguous, about half a line apart; a frontal more extended in the longitudinal direction, broader in front; two fronto-parietals; a short interparietal; two parietals; no occipital; a small naso-frenal; two frenals, and two freno-orbitar plates, the latter long and quadrilateral; seven superior labials, the sixth the largest, very distinctly oblong quadrilateral; four supraciliary plates; a transparent disk to the inferior eyelid; auditory opening simple, without scales; body rather long, surrounded with thirty rows of scales, more or less rounded posteriorly; scales tricarinate upon the back; carinæ indistinct; seven præanal scales, the two middle the largest. *Colour* olive above, with brown spots, arranged sometimes into two longitudinal rows; a brown band on each side, from one and a half to two lines in breadth, commencing behind the eye, passing over the ear, and losing itself upon the tail; extremities spotted with brown above; under parts silvery white, immaculate.

Dimensions.—Length of head, nine lines; greatest breadth, six; length of body to vent two inches, ten lines; of tail, three inches, eight lines. Total length, seven inches, three lines. Circumference, one inch, ten lines.

General Remarks.—Of the thirteen species of Euprepes described by Duméril and Bibron, none are mentioned as found in S. America. They are represented as existing in Africa, Egypt, Abyssinia, the Seychelles, N. Guinea, and various parts of the E. Indies and Indian Archipelago. Of the thirteen species, but two (E. Sebæ and E. Ernesti) are without a transparent eyelid. The plates upon the head in the different species of Euprepes often vary considerably. Thus, in Harlani, the first frenal is more slender than in striata; the fronto-nasals are nearer together, the interparietal is longer. The internasal in Surinamensis is broader, the fronto-nasals more quadrate, the frontal longer, the interparietal broader, and more urceolate, the fronto-nasal wider apart than in dissimilis, in which the fronto-nasals are closely in contact, separating the frontal from the internasal by an interval of half a line. In Surinamensis the frontal and internasal are in contact; the supranasals in Harlani and striata are unusually broad anteriorly; and in Blandingii, the fifth superior labial is remarkable for its quadrangular form and great length. Differences of this kind are in all probability constant with few exceptions, and should always be carefully represented by the artist, as the surest mode of distinguishing the species, and of obviating, in a great degree, the necessity for long and circumstantial descriptions. We hope the time is not far distant, when there shall be sufficient encouragement for superior artists to an exclusive devotion to the drawing of objects of natural history, for there is no doubt talent in abundance, but the demand for it has not been fully manifested.

SUB. GEN. PLESTIODON. D. AND B.

Characters.—Nostrils opening in the middle, or nearly in the middle of the nasal plate; two supero-nasals; palate with a large median fissure, broader at its anterior extremity; pterygoid teeth; scales smooth.

PLESTIODON SINENSE? D. AND B.

Characters.—Colour, olive above, with four more or less interrupted narrow dark-coloured bands upon the back and tail; scales of back and tail edged with yellow; twenty-four rows of scales.

Description.—Head cruciform, slightly swollen at the temples; nostrils lateral, opening in a single plate, two supero-nasals, broad, contiguous, an internasal; quadrangular, posterior angle acute, enclosed by the fronto-nasals; fronto-nasals in contact; in one of the specimens the fronto-nasal and internasal are fused into one plate; a frontal, hexagonal, broader in front; two fronto-parietals; an interparietal; two parietals; no occipital; a freno-nasal; a large and broad frenal; two freno-orbitar plates; seven superior labials;

auricular openings pyriform, the broadest end above; there are four small scales upon the anterior border; third and fourth fingers of equal length; body robust; scales hexagonal; twenty-four rows; tail long and tapering, robust, cyclo-tetragonal at base; posterior extremities much stouter than anterior; second toe much the longest, with fourteen distinct transverse scales beneath; palms of anterior and soles of posterior extremities tuberculated; six pre-anal scales, the two middle ones quite large. *Colour.*—Olive above, with four dark-coloured, and more or less interrupted bands upon the back and tail; the black spots constituting narrow bands, which are not very distinct, occupy only the posterior half of each scale; in some specimens they are much larger than in others; posterior part of scales upon sides marked with black; edges yellow. Pterygoid teeth.

Dimensions.—Length of head ten lines; greatest breadth six and a-half lines; length of neck and body to vent, three inches; (Fr.) of tail, four inches, five lines; total length, eight inches, three lines; circumference of body, two inches, two lines; of tail at base, one inch, seven lines; another specimen measured nine inches in length; and the circumference of the apparently older one was two inches, eight lines.

Habitat.—Ningpo, China. Five specimens in Mus. Acad. N. S., presented by B. H. M'Cartee, M. D.

General Remarks.—The animal above described is very probably the Plestiodon Sinense, (Duméril and Bibron,) from the neighbourhood of Canton, their description of the scales corresponding with it, being olive-coloured bordered with yellow; but they make no mention of the four dotted lines along the back; which, however, are shown in Gray's figure. (Hardwicke—Illustrations of Indian Zoology—Tiliqua rubriventris,) and they give one more row of scales, viz.;—twenty-five. We have a specimen with three white lines down the back, bordered with black, probably the young of the above, and which is, perhaps, identical with Plestiodon pulchrum, Dum. & Bib. An Tiliqua trivittatus? Gray.

We have carefully examined the Herpetology of Duméril and Bibron, the most complete and philosophical that has yet been published upon the Reptiles, and the Catalogue of the Reptiles of the British Museum, by Mr. Gray, and do not find any species of Scinks corresponding with those above described as new.

Among the Scincidæ in the collection of the Academy are fourteen specimens of Ablepharus Peronii, belonging to the group of Scincidæ Ophiopthalmidæ of Duméril and Bibron; the greater number presented by Dr. Townsend; the predominating colour in most of these specimens is brown, mingled with green, with the lateral rays bordered with black, as described by Duméril and Bibron. In some of the specimens, however, the predominating colour is brownish above, with two median rows of black spots. Duméril and Bibron observe that this species has a very wide range, being found, according to them, in New Holland, Tahiti, Java, the Isle of France, the Morea, and Peru.

ARTICLE V.

NOTICE OF REMAINS OF THE WALRUS DISCOVERED ON THE COAST OF THE UNITED STATES.

BY JOSEPH LEIDY, M. D.

[Read, June 20, 1856.]

Well-authenticated remains of the Walrus appear never to have been discovered in any other than the most recent geological formations.

In a report presented to the Lyceum of Natural History of New York, Messrs. Mitchell, J. A. Smith, and Cooper, give notice of the discovery of a specimen, consisting of the anterior portion of a Walrus skull, from the sea beach of Accomac Co. Virginia.* These gentlemen observe that the fragment bears the greatest resemblance to the corresponding portion of the skull of the existing species of Walrus, as compared with the figures given by Cuvier in the "Ossemens Fossiles." The specimen now preserved in the cabinet of the New York Lyceum, is represented in two outline figures by De Kay, who under the impression that it indicates an extinct species, has given for this the name of *Trichecus Virginianus*.†

In the summer of 1853, Professor J. F. Frazer of this city discovered the skull of a Walrus on the sea beach at Long Branch, Monmouth County, New Jersey. The specimen which has lately been presented to the Academy of Natural Sciences, has lost a portion of the cranium proper, and the exserted portion of one tusk, but otherwise, except being a little water worn, is in a good state of preservation. It is unchanged in texture, and nearly so in colour; and it belonged to an old individual, as all the sutures are completely obliterated. (Plate IV., fig. 1; V., fig. 1.)

* Annals of the Lyceum of Natural History, II. 271.

† Natural History of New York, Part I. Zoology, p. 56; pl. XIX. figs. 1 a, b.

The form of the facial portion of this specimen corresponds with that of the specimen from Virginia, above mentioned; and the entire skull closely resembles that of the recent Walrus, *Trichecus rosmarus*, as represented in the figures of Daubenton, Cuvier, and De Blainville; and its measurements also are sufficiently near those given by the first named author to recognise it as the same species.*

The tusks in the fossil curved downwardly in a diverging manner, and were about four inches distant from each other at their emergence from the alveoli, and ten inches at their tips. The remaining tusk in the specimen, is thirteen inches long from its alveolar border, and in this latter position it is three inches in diameter antero-posteriorly and one and three-quarter inches transversely.

The second incisor, and the succeeding three molar teeth, contained in the specimen, occupy an extent antero-posteriorly of four and a quarter inches. These teeth are quadrately rounded at their alveolar orifices, and are worn away at their triturating surfaces in an irregularly oblique manner. The first molar tooth is the smallest of the series; and the incisor and the other molars are of nearly equal size.

Quite recently Professor Geo. H. Cook, of New Brunswick, New Jersey, sent for my inspection, the facial portion of a Walrus skull, which also was discovered on the sea beach of Long Branch, New Jersey. The specimen was kindly loaned to Professor Cook by the Rev. Mr. Finch, of Shrewsbury, to whom it now belongs. It is unchanged from its original texture, but is brown from the infiltration of oxide of iron. It also belonged to an old individual, as all the sutures are obliterated, and the third molars together with the greater extent of their alveoli are gone. (Pl. IV., fig. 2.) In its anatomical details the specimen agrees with the corresponding portion of Professor Frazer's specimen, except that it is an inch and a half broader in the position of the canine alveoli, and the antero-posterior diameter of the tusks is rather less.

An important question now arises in relation to the age or geological period to which the three Walrus skulls, thus discovered on the coasts of New Jersey and Virginia, belong. As they appear to be of the same species as the recent *Trichecus rosmarus*, which once lived in great numbers in the Gulf of St. Lawrence, they are most probably the remains of individuals that were once floated upon fields of ice southerly, and left on the present United States coast. Or, perhaps they may be the remains of the same species which probably during the glacial period extended its habitation very far south of the latitude in which it has been found in the historic age.

* Histoire Naturelle, etc. T. XIII. 423.


2.a
2.b

MEASUREMENTS OF THE FOSSIL WALRUS SKULLS.

	Prof. Frazer's specimen.	Mr. Finch's specimen.
Greatest length of skull estimated,	15 inches.	
Length from mastoid ridge to front of canine alveolus,	12 "	
Greatest length of tempero-orbital fossa,	8½ "	
Length of skull from summit of tempero-occipital ridge to end of nose,	10½ "	
Breadth of narrowest portion of cranium,	3 "	
Breadth of cranium at mastoid processes,	11 "	
Breadth of face at canine alveoli,	8 "	9½ inches.
Height from palatal border to end of nose,	5¼ "	5 "
Height of anterior nasal orifice,	2 "	2 "
Breadth " " "	2¼ "	2¾ "
Length of exserted portion of tusks,	13 "	
Antero-posterior diameter of tusks at alveoli,	3 "	2¾ "
Transverse " " "	1¾ "	1¾ "
Distance of tusks from each other at alveoli,	4 "	3¾ "
Distance " " " tips,	10 "	
Length of inciso-molar series,	4¼ "	4¼ "
Distance apart of third molars,	2¾ "	2½ "
Distance apart of incisors,	11 lines.	14 lines.
Antero-posterior diameter of incisors,	14 "	14 "
Transverse, " "	11 "	11 "
Antero-posterior diameter of first molar,	9 "	8½ "
Transverse, " " "	10 "	10 "
Antero-posterior diameter of succeeding molars,	12 "	13 "
Transverse, " " "	12 "	14 "

In the course of the preceding investigations I was led to examine a specimen, in the cabinet of the Academy of Natural Sciences, consisting of the stuffed skin of a portion of the head enveloping the jaws of a species of Walrus apparently differing from the true *Trichecus rosmarus*, of which, as characteristic, I have viewed the figures of the skull and skeletons as given by Daubenton, Cuvier, and De Blainville. The specimen was presented by Sandwith Drinker, Esq., of Canton, China, and was probably derived from the Asiatic shore of the Arctic Ocean. From the worn condition of the upper incisors and molars, it appears to have belonged to an old individual; and in the case of the lower jaw, the teeth appear to have been entirely worn out. The tusks are very much longer and are narrower than in the *T. rosmarus*, and they curve downward, outward, and inward, instead of continually diverging, as in this species. At their emergence from the alveoli the tusks are two and three-quarter inches apart, near their middle five and a quarter inches, and at their tips only one inch. Their length is twenty-two inches and their diameter

at the alveolar border antero-posteriorly two and a quarter inches, and transversely one and a half inches. Towards their lower part they are twisted from within, forwards and outwardly.

Pennant, in speaking of the Walrus of Nova Zembla and the Frozen Sea, observes, "I entertain doubts whether these animals are of the same species with those of the Gulf of St. Lawrence. The tusks of those of the Frozen Sea are much longer, more slender, and have a twist and inward curvature."*

The superior incisor and molar teeth also are very much smaller than in the fossils of *T. rosmarus*, as may be seen by comparing the following measurements with those already given.

Diameter of the upper second incisor,	5½ lines.
Diameter of the upper first molar,	4½ "
Diameter of the upper second molar,	8 "
Diameter of the upper third molar,	7 "

The hairs of the upper lip of the *T. rosmarus* are stated by Shaw, to be about three inches long, and almost equal to a straw in diameter.† In the specimen under consideration, the hairs of the moustache are stiff-pointed spines, not more than one line long at the upper part of the lip, and they gradually increase in size, until at the lower and outer part of the lip they are about one inch in length.

[Dec. 22, 1856. Since presenting the above communication to the Society, the Academy has received from Mr. Drinker, of Canton, an entire specimen of the Walrus of Northern Asia. In this individual, which measures in a straight line eight feet from the nose to the tail, the tusks are ten inches long, and diverge from their alveoli to the tips, where they are five and a half inches apart, but they are slender, as in the stuffed head above mentioned, and appear as if they would ultimately have obtained the same length and direction. Perhaps the peculiarities noticed may prove to be of a sexual character.]

Plate IV., Fig. 1. Side view of the fossil skull, of the Walrus discovered by Professor Frazer, one-half the diameter of nature. Fig. 2. Inferior view of the specimen discovered by Mr. Finch, also reduced one-half.

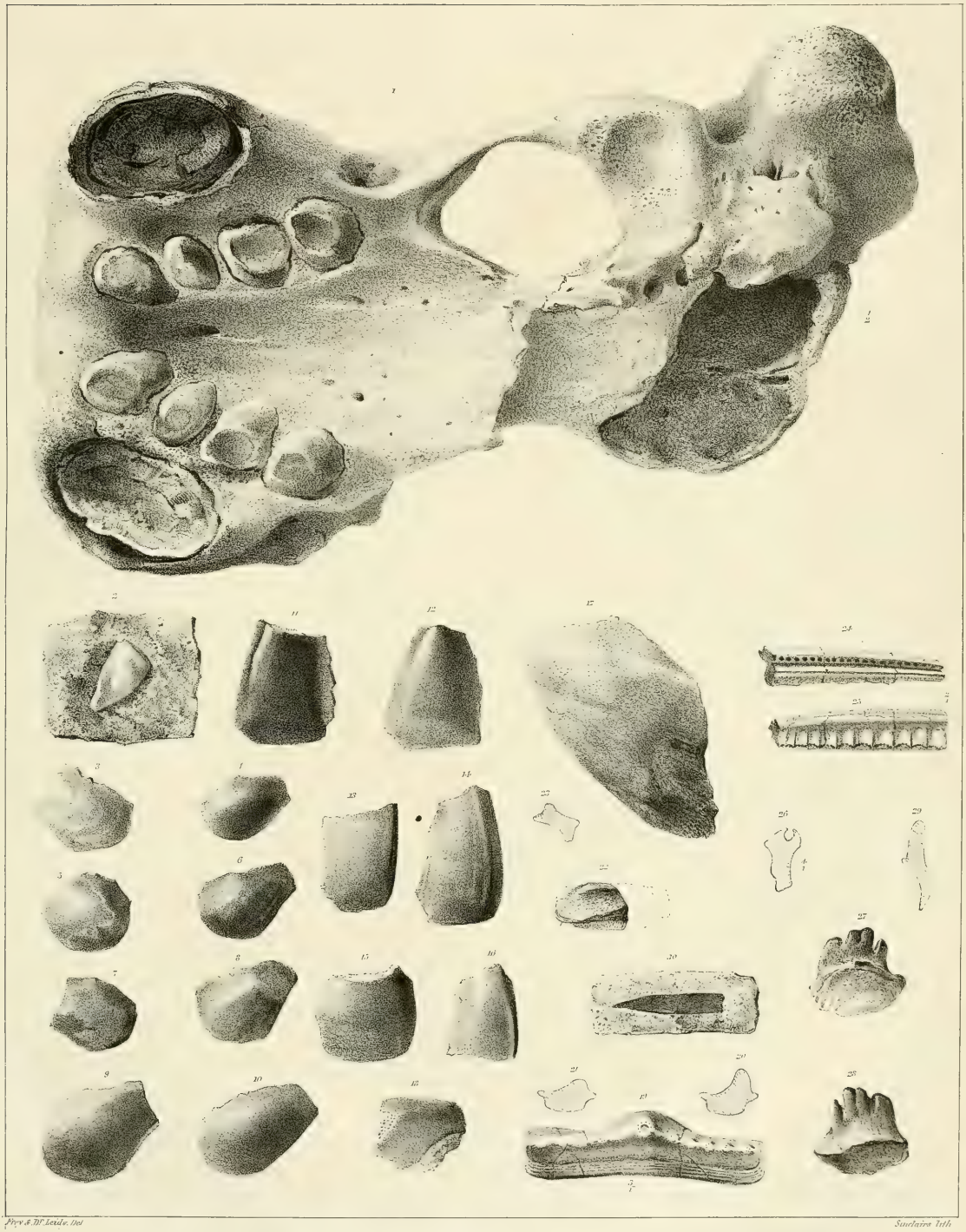
Plate V., Fig. 1. Inferior view of Prof. Frazer's specimen.

* Arctic Zoology, I. 170.

† Shaw's Zoology, vol. I. Pt. I. p. 234.

Fox Del

Sartain lith



Pryr & Mr. Leidy, del. Sartlaire lith.

1. Trichecus rosmarus fossilis. 2. Cochlodus nitidus, Leidy. 3-16 C. occidentalis, Leidy. 17 C. latus, Leidy. 18. Helodus gibbus, Leidy. 19-21. Chomatodus venustus Leidy. 22-23. C. obscurus, Leidy. 24-26. Palaeobatis insignis, Leidy. 27-29. Ctenoptychius digitatus, Leidy.

ARTICLE VI.

DESCRIPTIONS OF THE REMAINS OF FISHES FROM THE CARBONIFEROUS LIMESTONE OF ILLINOIS AND MISSOURI.

BY JOSEPH LEIDY, M. D.

[Read July 18, 1856.]

The present communication consists of short descriptions of remains of Cestraciont fishes, principally discovered by Dr. Benjamin Shumard of St. Louis, in the Carboniferous Limestone of Illinois.

From the variety in form of the teeth in different positions of the jaws of *Cestracion Phillippii*, the only surviving member of its family, we may infer that in the determination of extinct species from isolated teeth, which form the usual condition of the remains of Cestraciontes, we may consider as characteristic of several genera and species what may really belong to a single species. Under the circumstances the error is perhaps unavoidable; and it must be left to subsequent discovery, in which entire series of teeth in their original relationship may be found, to correct the error.

COCHLIODUS AG.

1. COCHLIODUS NITIDUS, Leidy.

This species is proposed on the specimen of a tooth, apparently from the left side of the lower jaw. The tooth is trilateral in outline, with the inner border convex, the anterior thick and straight, and that postero-externally straight and oblique in its direction. The triturating surface is transversely convex, with an anterior narrower and a posterior broad groove dividing three ridges crossing the tooth obliquely. Structure finely porous. Length from the posterior to the anterior angle seven lines; breadth of anterior border four and a half lines; breadth of inner border six lines.

Locality.—Carboniferous limestone of Chester, Illinois. Plate V., Fig. 2. Tooth of *Cochliodus nitidus.*

2. Cochliodus occidentalis, Leidy.

This species is proposed on eight more or less imperfect specimens of teeth. In their perfect condition, the teeth have a trilateral outline; are strongly curved transversely; and have the outer extremity narrow, the inner border convex, the anterior part recurved, and the posterior border thick and slightly concave. The posterior two-thirds of the triturating surface are prominently convex and smooth, or wrinkled transversely or longitudinally. Structure coarsely porous. Antero-posterior diameter from eight lines to nearly an inch; transverse diameter from eight lines to one and a quarter inches.

Locality.—Carboniferous limestone of Warsaw, Illinois. Besides the preceding specimens there were discovered in the same locality fragments of six larger teeth, which are too imperfect to judge of their form. Possessing the same structure as those just described, they may probably be the middle teeth of the series in the jaws. The largest of the specimens is three lines thick, and all appear as if they might be the greater portion of trilateral plates. Their triturating surface is moderately convex and smooth, or slightly wrinkled. At one broken border it appears as if it were recurved, and at the opposite border it turns downwards at right angles, and what is probably the inner border is thick and convex.

Plate V., Figs. 3—10. Teeth of *Cochliodus occidentalis.* Figs. 11—16. Six fragments of teeth last referred to in the above description, and probably belonging to *C. occidentalis.*

3. Cochliodus latus, Leidy.

This species is proposed on a fragment of a large tooth, apparently a second of the series in the jaw. In its perfect condition the tooth has been over two inches in length, and more than one and a half in breadth. The triturating surface presents two oblique convexities separated by a shallow depression, and there may have been a third ridge at the anterior border. The postero-internal angle of the specimen is abruptly bevelled off, apparently as the result of wearing. The structure is coarsely porous.

Locality.—With the preceding species.

Plate V., Fig. 17. Tooth of *Cochliodus latus;* the margins of the specimen being broken.

Helodus ag.

4. Helodus gibbus, Leidy.

This species is proposed on a single and imperfect specimen of a tooth, which in the fragment exhibits a prominent gibbosity obscurely divided into two. Surface coarsely porous. Height of crown three lines; probable length when perfect one and a quarter inches; probable breadth in the same condition seven and a half lines.

Locality.—The Carboniferous limestone of Warsaw, Illinois. Plate V., Fig. 18.

CHOMATODUS, AG.

5. CHOMATODUS VENUSTUS, Leidy.

This species is founded on the specimen of a tooth, the crown of which forms a narrow, oblong, quadrilateral plate elevated on the outer side, into an obtuse ridge. The latter rises towards its middle into a mammillary eminence with a truncated apex, centrally impressed and punctured at the margin. Along the summit of the ridge, to one side of the principal eminence, there are five other similar but comparatively minute ones, and on the opposite side there are several others nearly obsolete. The internal side of the crown is depressed, and is bordered by four or five delicate folds of ganoine, which are likewise in a much enfeebled condition, extended on the outer side of the crown. The root of the tooth is a narrow, thin, flat plate extending in the direction of the crown. Length of the specimen seven lines; breadth at middle two lines; depth at middle one and a half lines.

Locality.—From the Carboniferous limestone of Warsaw, Illinois. Plate V. Fig. 19. Triturating surface of the tooth of *Chomatodus venustus*, magnified three diameters. Fig. 20. Profile section of the same tooth at the middle; three diameters. Fig. 21. Profile section at one side.

6. CHOMATODUS OBSCURUS, Leidy.

This species is proposed on a fragment of a tooth, the crown of which in its perfect condition appears to have been an oblique, oblong, quadrilateral plate, with an obtuse, compressed hemi-elliptical ridge extending along the outer part of the triturating surface. The latter is bordered by a basal ridge apparently worn smooth in the specimen, except in one position, where it exhibits five folds of ganoine. The root is hemi-elliptical, extended in the length of the crown, and is twice the depth externally that it is internally. Height of the specimen four and a quarter lines; antero-posterior diameter of the crown, when perfect, about four and a quarter lines; probable transverse diameter twice its present extent, which is seven lines; depth of root internally two lines, externally four lines.

Locality.—The Carboniferous limestone of Warsaw, Illinois. Plate V. Fig. 22. Triturating surface of the tooth of *Chomatodus obscurus.* Fig. 23. Profile section of the tooth.

PALAEOBATIS, Leidy.

7. PALAEOBATIS INSIGNIS, Leidy.

This species is proposed on a fragment of a remarkable tooth, recalling to mind one of the dental plates of *Myliobates*, of which plates the specimen apparently corresponds to the half of one. The upper surface of the crown is a linear plane, and its posterior side presents a single row of deep pits, of which about four may be counted in each line of extent; and below the row of pits a band-like basal ridge without folds, separates the crown,

from the root of the tooth. The anterior side of the crown has developed from it a scroll-like ridge, the edge of which is nearly on a level with the triturating surface, and includes between it and the latter a wide sulcus. The root posteriorly forms a nearly vertical plane, but anteriorly is subdivided into a series of demi-cylindrical fangs, confluent at their back part. The bottoms of these fangs exhibit the orifices of coarse nutritive canals; and the crown of the tooth is a very little more dense in structure than the root. The transverse diameter of the specimen in its present condition is eight lines, but in its perfect condition has probably been twice this extent. The antero-posterior breadth of the crown is one and a quarter lines, and the height one and three quarter lines.

Locality.—The Carboniferous limestone of Warsaw, Illinois.

The specimen upon which this species is founded appears to resemble the figure 9, of table 12, in volume iii., of Agassiz' Poissons Fossiles, representing the tooth of *Chomatodus linearis*, but the figure is so obscure that I can make nothing of its details.

Plate V. Fig. 24. Posterior view of the tooth of *Palaeobatis insignis;* magnified two diameters. Fig. 25. Anterior view of the same tooth; magnified to the same extent. Fig. 26. Profile section of the same tooth; magnified four diameters.

Ctenoptychius, Ag.

8. Ctenoptychius digitatus, Leidy.

The species is proposed on a fine specimen of a remarkable-looking tooth discovered by Mr. Koch, the celebrated explorer of extinct animal remains, and presented by him to Dr. Shumard of St. Louis.

The crown is palmate in form, with the sides vertical, excepting that the outer one slopes inferiorly to the basal ridge. The summit is divided into four unequal, thick, obtuse, digitate processes, of which the median pair are confluent. The basal ridge descends much lower externally than internally, and in the former position is acute, in the latter thick, and presenting only the faintest trace of folding. The root slopes inwardly from the basal ridge on the outer side, and its inner side presents an extensive shallow excavation. Length of the specimen nine lines; breadth nine lines; length of the crown externally six lines; internally three and a half lines; depth of the root externally three and a half lines; internally five lines.

Locality.—Carboniferous limestone, near St. Louis, Missouri. Plate V. Fig. 27. Internal view of the tooth. Fig. 28. External view. Fig. 29. Profile section.

ARTICLE VII.

REMARKS ON SAUROCEPHALUS AND ITS ALLIES.

BY JOSEPH LEIDY, M. D.

[Read November 21, 1856.]

THE genus *Saurocephalus* was founded by Dr. Harlan on a specimen consisting of the greater portion of the right upper maxillary bone with teeth of a sphyrænoid fish, discovered in a cavern on the Missouri River, and which probably belonged to the cretaceous period. The animal was supposed by Dr. Harlan to have been a saurian, and to the species he gave the name of *S. lanciformis.*

A second and much smaller species was subsequently described by Dr. Hays under the name of *Saurodon Leanus*, from a specimen consisting of the upper and lower jaws, obtained from the green sand of New Jersey, and now in the possession of Dr. Isaac Lea, who has kindly loaned it to me for inspection. Dr. Hays was aware that the animal indicated by this specimen belonged to the same genus as the species described by Dr. Harlan with the name of *Saurocephalus lanciformis*, but conceiving the generic name not appropriate, changed it to that of *Saurodon.*

In both species the superior maxillary bone is a trapezoidal plate a little convex externally and concave internally. Its two longer borders are the dental border, and the upper one, which is directed backward and downward, and externally is jagged as if for sutural connexion with other bones. The posterior border is also jagged, yet it is too imperfect in the specimens to judge accurately of its natural condition. The anterior border is longer than that just indicated, and in the specimen of *Saurocephalus Leanus* is united by suture with the premaxillary bone. (Pl. VI. fig. 8, 12 a.)

The number of teeth occupying the maxillary bone of *S. Leanus* (fig. 12 a,) appears to be thirty-six, but in *S. lanciformis*, (fig. 8,) so far as can be judged from the imperfect specimen under consideration, the number appears to have been eight or ten less.

The teeth in the corresponding bone of both species are very nearly alike in form; and they have the same mode of insertion and order of succession as in the existing *Sphyræna.* The crown or exserted portion of the tooth, with a thin enameloid investment, is compressed conical, with trenchant borders and an acute summit. The transverse section near the base is carinated at the poles, convex externally, and trilateral internally. In *S. lanciformis* the crown is straight; its breadth equal to its length, and the thickness half the extent of the breadth; and the trenchant borders are finely denticulate. In *S. Leanus* the crown is slightly curved inwardly; its length is a third greater than the breadth; and the trenchant borders are entire, and extend more upon the fang than in the former. The fang is from two to three times the length of the crown, and tapers towards its free extremity. Internally it is convex, and externally trilateral with the intermediate face grooved, which condition often extends upon the corresponding face of the crown as represented in the enlarged figure 15.

The surface of the crown is striate, but so very minutely that the elevation of the striæ is hardly perceptible. This condition is distinct from the more visible structural folding in the enameloid substance.

In the maxilla of *S. lanciformis* a layer of coarsely granular ossific substance, which invested its outer surface, accumulates at the dental border and envelopes the base of the teeth, and on the inner side of the jaw is defined by a groove containing a series of foramina communicating with the cavities of the successional teeth. In *S. Leanus* a similar layer invests the outer face of the jaw, but does not accumulate at the dental border, where it ceases abruptly. In this species on the inner side of the dental border, vertical notches exist opposite the teeth, terminating below in foramina communicating with the reserved cavities for the successional teeth, as seen in fig. 13.

In the specimen of *S. Leanus* the premaxillary is a quadrate curved bone united by suture with the anterior border of the maxillary, and turned inward at the border where it joins the corresponding bone of the opposite side. Its dental border appears to have supported ten teeth, of which those posterior are of the same size and form as those of the maxillary bones, and the anterior ones, though broken away, judging from the remains of their alveoli, appear also to have been of the same size. The contiguous parts of the premaxillary and maxillary bones at their upper part support a tubercle with a smooth surface, as in fishes ordinarily. (Fig. 12, a, b.)

In the shortness of the premaxillary, its union and continuity with the maxillary, and the support of teeth by the latter, we have an extraordinary variation from the condition of things as existing in the living *Sphyræna;* and indeed the two bones in their form, relative position, union, and continuity of the dental borders, exhibit a striking resemblance to the same parts in the lacertian reptiles.

The lower jaw of *Saurocephalus*, as indicated in the specimen of *S. Leanus*, preserves much more the form and general appearance of that of *Sphyræna* than the upper one. The dental bone has nearly the same outline of form as in the latter, but it is deeper in relation with its length, and is less convex externally. Its symphysis presents very much the appearance of that of *Sphyræna*, though I am not satisfied that the comparatively feeble tubercle antero-internal to the dental border supported a large tooth as in this genus, and of which I can detect no trace. The articular bone holds the same relative position as in *Sphyræna*, as does also its articular process, which is however much more vertical in its direction. (Fig. 14.)

The dental border of the lower jaw appears to have supported about forty-two teeth, which have nearly the same size and form as those of the upper jaw, in which respect this genus further strikingly differs from *Sphyræna*. The inner side of the dental border with its notches presents the same appearance as in the upper jaw.

The more uniform size of the teeth in both jaws of *Saurocephalus* approaches the genus more closely to another extinct allied genus, *Sphyrænodus*, than to *Sphyræna*, and indeed I have a suspicion that a careful comparison of the specimens upon which the two former genera were founded may prove them to be identical.

Professor Agassiz has described and represented a number of isolated teeth (Pois. Fos. V. 102, pl. 25, c. figs. 21—29,) of a large sphyrænoid fish, from the chalk of Lewes, England, which he erroneously refers to the *Saurocephalus lanciformis*, Harlan. Although teeth of the size of those in the fragment of an upper jaw, described by Dr. Harlan, might be inferred from the examination of the *Sphyræna barricuda*, to be accompanied with teeth in the lower jaw, as large as those attributed to *S. lanciformis* by Agassiz, yet the jaws of *Saurocephalus Leanus*, prove this not to be the case.

The crowns of the teeth of *S. lanciformis*, Harlan, are almost as broad as they are long, and do not measure more than 2½ lines, whereas the corresponding portions of the teeth referred by Agassiz to this species, as represented in his figures, measure from 5 to 15 lines long, and from 2½ to 6 lines broad.

Dixon, in his Geology of Sussex, following Agassiz, refers portions of the lower jaw and teeth of a large sphyrænoid fish (pl. xxx. fig. 21; xxxi. figs. 12; xxxiv. fig. 11,) apparently the same as that indicated by the figures of Agassiz above noticed, also erroneously to the *Saurocephalus lanciformis*. In a note to page 375 of the same work, he further attributes the rostrum of a Xiphioid fish (pl. xxxii.* figs. 1) to *S. lanciformis*, to which it certainly does not belong.

Professor Owen's sectional view of the structure of the teeth of *Saurocephalus* (Odonto-

graphy, pl. 55,) was taken from a specimen obtained from Dr. Harlan, and is therefore correct as regards the genus to which it is referred.

Count Münster has described and figured remains, which he refers to three different species of *Saurocephalus* (Giebel, Fauna der Vorwelt, 88,) but to his work I have not had access, and cannot therefore know whether he is correct or not.

Reuss (Verst. d. Böhm. Kreideform. 13, pl. iv. fig. 67) has described an isolated tooth of a fish, which he attributes to the *Saurocephalus lanciformis,* but it does not belong to this, and I think it doubtful even whether it belongs to the same fish supposed to be that species by Agassiz.

Gervais (Zool. e. Palæont. Franc. pl. 70, figs. 5—7,) has represented several large teeth which he attributes to the *Saurocephalus* of Harlan, but these belong to the fish supposed to be of that genus by Agassiz.

To *Saurodon Leanus* Hays, Agassiz has erroneously referred the fragment of a palate bone with teeth (Pois. Foss. v. 102, pl. 25 c. figs. 30, 31) of another large sphyrænoid fish from the chalk of Lewes, England. Though the true *Saurocephalus* may have had semi-barbed teeth to the palate bone, like those just referred to in the fragment described by Agassiz, yet this could not fairly be inferred from the condition of the living *Sphyræna.*

Dixon has noticed and represented (Geol. Sussex, 373, pl. xxx. figs. 28, 29; xxxii.* fig. 10) several large, isolated, semi-barbed teeth, and a lower jaw and palate bone with teeth, which following Agassiz, have been referred to *Saurodon Leanus,* Hays, to which they certainly cannot belong. The teeth in the lower jaw just mentioned, resemble in form and size those attributed to *Saurocephalus striatus* (Agassiz, Pois. Foss. v. 102, pl. 25 c. figs. 17, 20; Dixon, Geol. Sussex, 375, pl. xxxv. figs. 5,) and a careful examination of the specimens may prove the remains referred by Agassiz and Dixon to the latter and to *Saurodon Leanus* to belong to the same species of fish, though not the *Saurodon Leanus* described by Dr. Hays.

In concluding the above remarks, I have prepared the following corrected list of the fishes which have been attributed to the *Saurocephalus* of Harlan.

1. Saurocephalus lanciformis, Harlan.

Jour. Acad. Nat. Sci. iii. 337, pl. xii. figs. 1—5; Med. a. Phys. Res. 362, pl. figs. 1—5; Trans. Geol. Soc. i. 87; Owen: Odontography, 130, pl. 55.

Saurodon lanciformis Hays: Trans. Phil. Soc. iii. 476, pl. xvi. fig. 11.

2. Saurocephalus Leanus, Harlan.

Saurodon Leanus Hays: Trans. Am. Phil. Soc. iii. 477, pl. xvi. figs. 1—10.

Saurocephalus Leanus Harlan: Trans. Geol. Soc. i. 87.

3. PROTOSPHYRAENA FEROX, LEIDY.

Saurocephalus lanciformis Harlan, Agassiz: Pois. Fos. v. 102, pl. 25 c. figs. 21—29; Dixon: Geol. Sussex, 374, pl. xxx. fig. 21, xxxi. 12, xxxiv. 11; Pictet: Traité d. Palæont. pl. xxxii. figs. 7; Giebel: Odontog. pl. xliii. fig. 7; Reuss: Verst. Böhm. Kreidef. 13, pl. iv. fig. 67?

Tooth of an unknown fish, and tooth of a species of Squalus, Mantell: Geol. Sussex, 227, 228, pl. xxxiii. figs. 7, 9.

Saurocephalus Harlan, Gervais: Pal. Franc. pl. 70, figs. 5—7?

4. PROTOSPHYRAENA STRIATA, LEIDY.

Saurocephalus striatus Agassiz: Pois. Fos. v. 102, pl. 25 c. figs. 17—20; Dixon: Geol. Sussex, 375, pl. xxxv. figs. 5.

5. CIMOLICHTHYS LEVESIENSIS, LEIDY.

Saurodon Leanus Hays, Agassiz: Pois. Fos. v. 102, pl. 25 c. figs. 30, 31; Dixon: Geol. Sussex, 373, pl. xxx. figs. 28, 29, xxxii.* fig. 10; Pictet: Tr. d. Pal. pl. xxxii. fig. 6.

(?) *Saurocephalus striatus* Agassiz.

6. XIPHIAS DIXONI, LEIDY.

Saurocephalus lanciformis Harlan, Dixon: Geol. Sussex, note to p. 375, pl. xxxii.* figs. 1.

Plate VI. fig. 8. Greater portion of the left superior maxilla of *Saurocephalus lanciformis* Harlan, natural size.

Fig. 9. One of the teeth, magnified three diameters.

Fig. 10. Section of the crown at base, magnified three diameters.

Fig. 11. Section of the fang, magnified.

Fig. 12. Left maxillary (a,) and pre-maxillary (b,) of *Saurocephalus Leanus* Harlan, natural size.

Fig. 13. Internal view of the same specimen.

Fig. 14. Left ramus of the lower jaw of *S. Leanus*.

Fig. 15. Upper tooth, magnified four diameters.

ARTICLE VIII.

OBSERVATIONS ON THE EXTINCT PECCARY OF NORTH AMERICA; BEING A SEQUEL TO "A MEMOIR ON THE EXTINCT DICOTYLINÆ OF AMERICA."

BY JOSEPH LEIDY, M. D.

[Read November 21, 1856.]

In attempting to determine extinct animals from a few remains, we are frequently perplexed to know whether one or more species of a genus or of several genera are indicated. Were specific characters unvarying, which perhaps could not be the case, the difficulty though lessened would not be removed, for recent animals exhibit the fact, that while many species are well characterized by external marks, they are not so by the dentition and skeleton.

At the period of publishing "A Memoir on the Extinct Dicotylinæ of America," in the Transactions of this society, (Vol. X., p. 323,) feeling dissatisfied with the results, I determined to reinvestigate the subject, which having done, with the aid of additional material both recent and fossil, I have come to the conclusion that all the Dicotyline animals supposed to be indicated by the fossil remains, described in the memoir just mentioned, really belong to one species of Peccary.

In comparing a considerable number of skulls of the recent *Dicotyles torquatus*, I find that variations occur equal in value to the characters upon which the different Dicotyline genera and species have been proposed by Dr. Le Conte and myself.

Notice of variations in the skull of the recent Dicotyles torquatus.—The skull of *Dicotyles torquatus* varies considerably in size; the smallest and largest adult specimens observed differing more than an inch in length. It also varies in the breadth and convexity of the forehead; in the length and thickness of the parietal crest; in the width and prolongation of the face; in the degree of extension forward of the malar ridge; in the concavity of the malar bones; in the extent of inversion of the angle of the lower jaw; the breadth of the

symphysis; and indeed hardly an anatomical feature can be mentioned which does not present considerable variation among a large number of skulls.

In examining the dentition, all the teeth will be found to vary considerably in size, though generally only in proportion with a variation in the size of the skull. The crowns of the first and second lower incisors indicate more or less tendency to become bilobed; sometimes the appearance is quite strong, at others feeble. The crowns of the upper incisors, vary in the degree of development and irregularity of their basal ridge, and in the degree of concavity of their interior surface. The canines vary in robustness and in the degree of divergence. Those below differ in the extent of development of the exterior ridge, which is sometimes very prominent, and occasionally is nearly obsolete. Usually the upper ones have an even surface, but sometimes present a longitudinal groove on one or both sides. As the crowns of the canines are worn down, their fangs become thickened by a deposit of cementum.

Of the inferior molars, the last true one varies considerably in its exact form and proportions. It is oblong ovoid, trilateral, or oblong square. It sometimes presents five, nearly uncomplicated, mammillary tubercles; at others the unsymmetrical tubercle is more or less subdivided, and the crown generally presents a more complex appearance by the introduction of offsets from the principal tubercles; and sometimes the fifth lobe degenerates into a thick basal ridge. The anterior true molars vary in the extent of corrugation of their lobes. The inferior premolars vary considerably in form. Their crown generally is ovoid, and usually presents in succession a small anterior tubercle, a transverse pair of large mammillary tubercles, and a broad tubercular heel. The anterior tubercle is sometimes nearly obsolete, especially in the first premolar, and occasionally in the last one. Not unfrequently the last premolar assumes the appearance more or less complete of a true molar.

The superior molars vary in corresponding characters with the lower ones. The last of the series has a more or less square, or ovoidal crown, is variably corrugated, and has a posterior basal ridge varying in extent of development. The last premolar varies in form from that of the teeth preceding it to that of the succeeding true molars. The second premolar resembles the one below, except that it is more square; and sometimes, it also assumes the appearance of a true molar. The crown of the first premolar varies in the degree of development of its tubercles and basal ridge.

The value of sexual differences in the skull of *Dicotyles torquatus*, I have not been able to ascertain for want of authentic specimens of the two sexes, but perhaps the smaller skulls with less robust teeth, above indicated, belong to the female, while the others belong to the male.

Remarks on the discovery of remains, and distinctive characters of the extinct Peccary.—Remains of the Peccary have been discovered in Illinois, Kentucky, Iowa, Missouri, and Virginia. The most important specimen yet obtained of these remains, is a nearly perfect skull, completely unchanged in original texture, which was found in a saltpetre cave in Kentucky, and was presented by Dr. Samuel Brown, in 1805, to the American Philosophical Society, in the cabinet of which it remained for nearly half a century with the impression of all who examined it, that it was the skull of a recent Peccary. More accurate information of the exact locality in which the specimen was found I have not obtained.

The first remains of the extinct Peccary of North America were described by Dr. John L. Le Conte, from specimens obtained by Mr. Snyder, of Galena, Illinois, in the vicinity of that city. These remains consisted of a number of bones and teeth, with fragments of others, and were found in association with remains of an extinct species of *Procyon* and a tooth of an extinct genus to which Dr. Le Conte gave the name of *Anomodon*.

In a recent visit to Galena, Illinois, through the aid of Dr. E. D. Kittoe, and Dr. Hempstead, of that city, I had an opportunity of examining the localities in which fossil remains of the Peccary are found; and Dr. Kittoe gave me a number of additional specimens. The localities referred to, occur in the cliff limestone,* which is widely extended through Wisconsin and portions of Illinois and Iowa, is full of irregular fissures containing lead ore, and is remarkable for the singular weather-worn and castellated appearance it presents in exposed situations. Within the lead-bearing crevices, in the vicinity of Galena, bones have frequently been found, and they may also have been discovered even more frequently in similar positions in Wisconsin, but as yet, I have seen no evidence of such discovery. The bones are generally exceedingly friable, often chalk white and resembling recent ones calcined; and they are enveloped in a loose or more or less compact matrix of brown ferruginous sand. Occasionally, the remains are found in abundance, and in one instance a miner informed Dr. Kittoe that for several days together he had been engaged in removing bones from a lead crevice, but not knowing they were of any value, they were thrown among other rubbish removed from the mine, where from their very great friability, they were soon destroyed through the action of the weather. At my instigation, Dr. Kittoe employed two miners to enter a deserted lead crevice, in which it was stated bones had been found; and after some trouble in removing rubbish that had fallen in from above, they obtained about a quarter of a peck of bones and fragments of the extinct peccary, together with a few fragments of bones and numerous incisor and a few molar teeth of four rodents. These latter may, on subsequent investigation, prove to be extinct species,

* An appropriate name given to it by Dr. D. D. Owen, who says this rock is a subdivision of the mountain limestone group.

but the remains are not distinguishable in anatomical character from the corresponding parts of the recent *Arctomys monax*, *Pseudostoma bursarius*, *Lepus sylvaticus* and *Arvicola*.

A list of the Dicotyline remains which have been obtained at Galena, is given in the concluding portion of this paper.

Of other remains of the Peccary, Dr. R. W. Gibbes obtained a small fragment of the lower jaw with a canine tooth, described by Dr. Le Conte, from Benton Co., Missouri, where it was discovered in association with the remains of the *Mastodon*.

Recently, Dr. Le Conte presented to the Academy of Natural Sciences, a small fragment of the lower jaw containing the last temporary molar tooth, of the extinct peccary, from Augusta County, Virginia.

Through the kindness of Professor Wyman, I have lately had the opportunity of examining a number of remains of the extinct peccary, discovered in Iowa, by Dr. Foster. The remains consist of one half of the lower jaw with the canine and molar teeth, the upper jaw with the molars, and a malar bone of an adult animal, together with fragments of the skull of a very young animal.

Upon the observed varieties of structure in the first collection of remains of the extinct peccary, obtained through Mr. Snyder of Galena, and described by Dr. Le Conte, were proposed the names of *Platygonus compressus*, *Hyops depressifrons*, *Dicotyles depressifrons*, *Protochoerus prismaticus*. Upon a small fragment of the lower jaw with one canine tooth of the same extinct species of peccary, from Benton Co., Missouri, also described by Dr. Le Conte, the name of *Dicotyles costatus* was proposed, and upon the cave head from Kentucky, described by myself, the name of *Euchoerus* (*Protochoerus macrops*) was proposed. All these I am now inclined to believe belong to a single extinct species of peccary, and must be included under the name of *Dicotyles compressus*, unless the anatomical characteristics, which have been given in detail in my former memoir on the Extinct Dicotylinæ of America, should be considered subgeneric, when the original name of *Platygonus compressus* must represent the whole of those which have been employed. All the points of variation in the different specimens described in the memoir just referred to, find their corresponding equivalents in different individuals of the recent *Dicotyles torquatus*, and therefore cannot be allowed to retain the value that we too hastily had given them.

The extinct *Dicotyles compressus*, was a little larger than the existing *Dicotyles labiatus*, and its other most important differences from this and the more common species, *D. torquatus*, chiefly observable in the skull, are briefly as follows. The face is more prolonged and narrower, the upper outline of the head is less inclined from the horizon, the forehead is much broader, the cheeks deeper, the orbits have a more supero-posterior position, the sides of the inion are less oblique, the technical angle of the lower jaw is strongly everted and the

symphysis is narrow and keeled, the incisor teeth are smaller, and the principal lobes of the molar teeth possess a greater proportionate degree of development.

Comparison in the varieties of dentition observed in Dicotyles compressus.—In figures 5, 6, plate 37 of volume X. of these Transactions, is given a representation of the right upper series of molar teeth, of the cave head, formerly viewed as characteristic of *Euchoerus macrops.* The teeth may be observed to be constructed on the same plan as those of the recent peccaries, but strikingly to differ in the greater degree of development of their primary lobes.

In figure 2, plate 6, accompanying this communication, is represented the corresponding series of teeth, from the Iowa fossil in possession of Dr. Wyman. These teeth have slightly more robust proportions than those in the cave head; and they also belong to an adult individual, whereas in the latter, the permanent premolars and last true molar, had not yet protruded from the gums. The crown of the last true molar in the Iowa fossil, is less narrowed posteriorly than in that of the cave head, its postero-external lobe is proportionately with its fellow much better developed, and the basal ridge does not extend exterior to the latter, as it does so conspicuously in the cave head. In the preceding true molars, the lateral offsets of the inner lobes are rather better developed than in the cave head. The crowns of the premolars have rather different outlines in the two fossils; and in the case of the first of the series, it is trilateral in the Iowa specimen, and quadrilateral in the cave head. In the last two premolars the thick basal ridge continues around the inner side in the former, as in the first premolar, but does not do so in the cave head.

In the imperfect series of isolated upper molars, represented in figs. 12, 13, plate 37, volume X., formerly referred to *Platygonus compressus*, a condition is observable in the last two true molars, so different from that in the teeth just disposed of, that if they had been discovered unassociated with congeneric remains, almost any naturalist would have supposed they belonged to a taperoid, rather than to a dicotyline animal. The crown of the last true molar, has its unsymmetrical lobe in a most rudimental condition; and it has a quadrilateral oval outline instead of being trilaterally ovoidal. In this and the preceding tooth trituration has advanced more in clearing out the transverse valleys, than in wearing away the summits of the lobes, so that the teeth have assumed an appearance resembling that of the inferior molars of the Tapir, whereas in the recent peccaries ordinarily, and as is also observable in the corresponding teeth of the Iowa fossil, fig. 2, plate 6, the summits of the lobes are worn away without clearing out the transverse valleys. These facts would lead to the supposition that we really had before us the remains of two distinct genera of animals in which the trituration of the teeth proceeded on a different plan, but an inspection of the first and second true molars in the cave head, and the inferior true molars of *Dicotyles compressus* led me to view the difference as only another individual peculiarity

of the fossil species just named. The premolars of the series under examination, fig. 12, pl. 37, resemble more closely those of the cave head than of the Iowa fossil, except the first tooth, which differs from the corresponding one of both these fossils in being smaller and in possessing but a single large conical lobe.

Figures 14, 15, pl. 37, vol. X., represent another imperfect series of isolated upper molars, formerly referred to *Platygonus compressus*, and these teeth nearly resemble the corresponding ones indicated in the former figures and those of the cave head.

Figure 11, pl. 37, further represents a series of unworn premolars contained in a fragment of a skull, formerly also referred to *P. compressus*, and these resemble the isolated ones of fig. 12, pl. 37, but unworn.

In figures 7, 8, plate 37, is given a representation of the inferior right series of molars of the cave head above referred to, in which the same striking increase in development of the principal lobes is observable, in comparison with their condition in the recent peccaries, as in the case of the upper molars.

In figure 3, pl. 6, we have a representation of a corresponding series of teeth, to that just indicated, from one of the Iowa fossils, in possession of Prof. Wyman. The teeth of this fossil are slightly more robust than those of the cave head, and the premolars are less square or are more laterally compressed, a variation which is frequent in different individuals of the recent *Dicotyles torquatus*. In the last true molar, the contiguous sides of the anterior pair of lobes are much less concave than in the cave head, and the unsymmetrical lobe is almost simple, while it is subdivided in the latter.

In an inferior series of molars, contained in a fossil fragment, from Galena, presented by Dr. Edward Kittoe, the teeth are considerably smaller than in either of the corresponding series just dispensed with, and the transverse valleys of the true molars appear rather more open in consequence of a less proportionate degree of development of the lateral offsets of the inner lobes. In the last molar the unsymmetrical lobe forms a single large conical tubercle.

Figure 10, plate 37, represents two inferior back molars, contained in the fragment of a lower jaw, formerly attributed to *Platygonus compressus*. The teeth pretty closely resemble the corresponding ones of the series last indicated in a more worn condition; and in the open transverse valleys, they bear much likeness to the opposing upper teeth of fig. 13, which accompanied them.

We further possess two isolated, slightly worn, back inferior molars, from Galena, one of which presents a variation from the more common condition in having its unsymmetrical lobe diminished in size and enclosed by a thick basal ridge.

Figure 18, plate 37, represents the fragment of a back inferior molar, formerly viewed

as characterizing *Protochoerus prismaticus.* In comparison with the last molars of *Dicotyles torquatus,* represented in figures 1 and 3, plate 37, it would be considered to belong to the lower jaw, but in comparison with the corresponding teeth in the cave head, figures 5 and 7, it would certainly be viewed as belonging to the upper jaw.

As indicative of the smaller size of the incisors of *Dicotyles compressus,* in comparison with those of the recent peccaries; representations of the following specimens, presented by Dr. Kittoe, are given in plate 6, accompanying this communication. Figure 4, an anterior view of the first superior incisor of the left side; figure 5, a view of the upper right lateral incisor; and figures 6, 7, lateral views of the first and second inferior incisors. The third inferior incisor, of the cave head, of *D. compressus* is represented in figure 19, plate 37, vol. X. of these Transactions.

List of remains of the extinct Peccary, (DICOTYLES COMPRESSUS,) *observed by the author.*—1. An almost perfect skull accompanied with the lower jaw, entirely unchanged in texture. It was discovered in a saltpetre cave in Kentucky, and was presented to the American Philosophical Society, in 1805, by Dr. Samuel Brown; and is now deposited in the cabinet of the Academy of Natural Sciences. It has lost a portion of the nasal bones, the incisors of both jaws, and one upper canine. On both sides it contains all the permanent molars, of which the premolars and the last true molar were just ready to be protruded. On one side in the upper jaw, three temporary molars are retained, but all the other series are lost, though they had not yet been shed. Trans. Am. Phil. Soc. 10, 342, plates 35, 36, 37, figs. 5—8. Referred to *Euchoerus* (*Protochoerus*) *macrops.*

2. Fragment of the right side of the lower jaw, of an adult individual, containing the last two molar teeth. Trans. Am. Acad. Arts and Sci. III., pl. 3, fig. 7; Trans. Am. Phil. Soc. X., pl. 38, fig. 3; pl. 37, figs. 9, 10. Referred to *Platygonus compressus.*

3. Fragment of the face, of a young animal, containing three premolars and portions of both canines. Trans. Am. Ac. Arts, III., pl. 1, 2, fig. 5 a.; Trans. Am. Phil. Soc. X., pl. 38, fig 2; pl. 37, fig. 11. Referred to *Platygonus compressus* and *Hyops depressifrons.*

4. Upper portion of the cranium. Tr. Am. Phil. Soc. X., pl. 38, fig. 1. Referred to *Hyops depressifrons,* and *Dicotyles depressifrons.*

5. Three imperfect series of upper molars, from two individuals. Tr. Am. Acad. III., pl. 3, figs. 12, 13, 13; Tr. Am. Phil. Soc. X., pl. 37, 12—15. Referred to *Platygonus compressus, Dicotyles depressifrons, Hyops depressifrons.*

6. An upper canine. Tr. Am. Acad. III., pl. 3, figs. 9—11; Tr. Am. Phil. Soc. X., pl. 37, fig. 16. Referred to *Platygonus compressus.*

7. Fragments of a frontal and malar bone, a dorsal and lumbar vertebra, the lower portion of a humerus, the left fore-arm bones, and a cuboid and metatarsal bone. Tr. Am. Acad. III., pl. 2, figs. 4, 5, b., 6; pl. 3, fig. 14; pl. 4. *Platygonus compressus.*

8. The fragment of a last molar tooth. Tr. Am. Phil. Soc. X., pl. 37, fig. 18. Referred to *Protochoerus prismaticus.*

9. Three inferior canines and a much worn lower molar tooth.

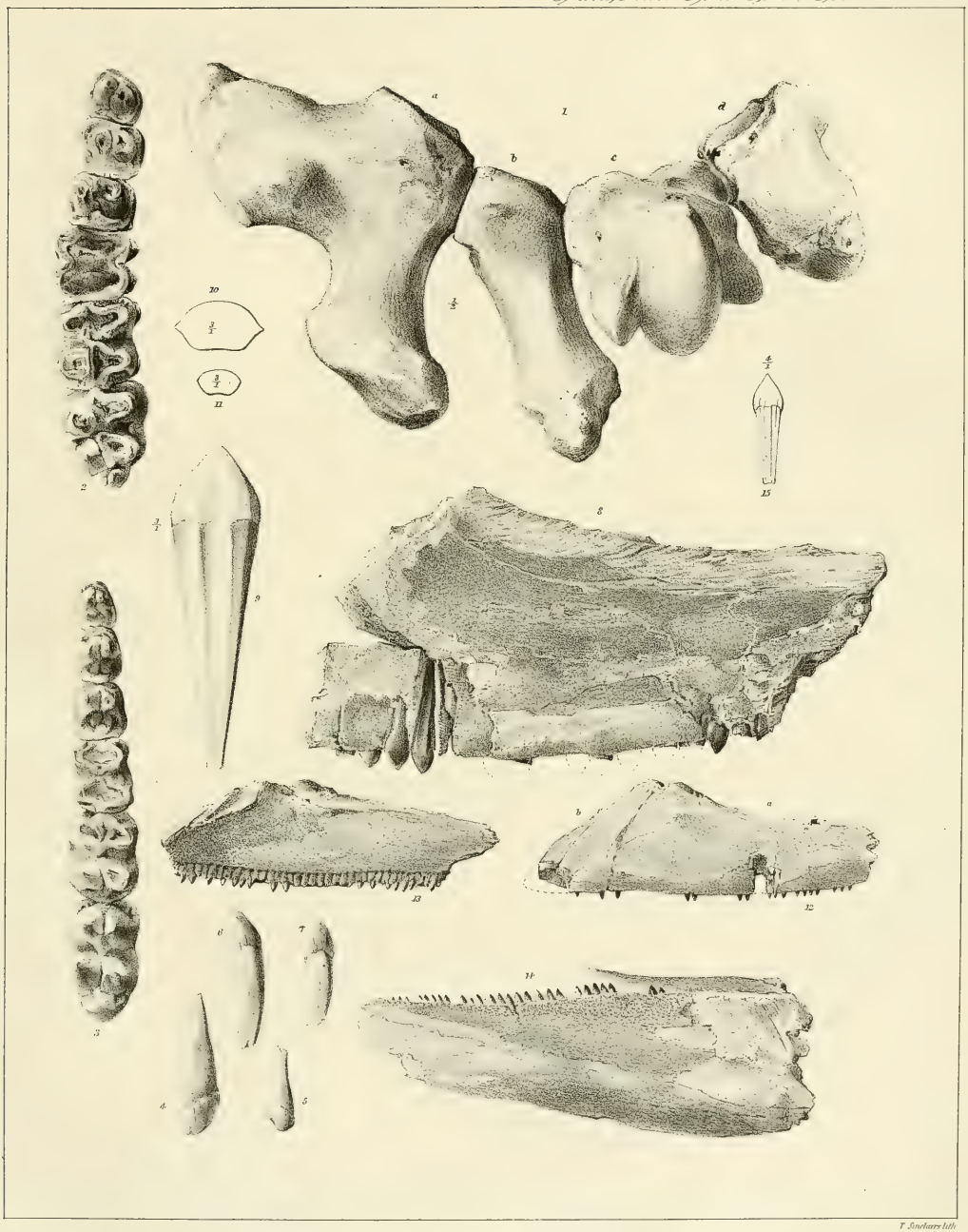
10. Small fragments of an upper and a lower jaw, of an atlas and of several ribs; three mutilated lower extremities of the humerus; fragment of a radius; two thirds of a hip bone and fragments of a second; an entire femur seven inches long and two and one third inches in circumference at the middle of the shaft; fragments of another femur, fragments of two tibiæ; three calcanea; two astragali; fragments of two metacarpals; two first phalanges, and one second phalanx. All these specimens appear to have been derived from three individuals, and the same to which the fragments belonged which were supposed to characterize *Platygonus compressus* and *Hyops s. Dicotyles depressifrons.*

The specimens of the list from number 2 to 10 inclusive, were obtained by Mr. Snyder of Galena, from the vicinity of that city, and have been presented by Dr. Le Conte, to the Academy of Natural Sciences, where they are now preserved.

11. The incisive portion of the lower jaw, with the right canine tooth. Referred to *Dicotyles costatus.* Obtained through Dr. R. W. Gibbes, from Benton Co., Missouri, where it was found in association with bones of the Mastodon, and presented to the Academy of Natural Sciences by Dr. Le Conte.

12. Two much worn upper and two lower canines; fragments of a lower jaw, with an entire series of molars of one side, and four molars of the opposite side; three last lower molars of as many other different individuals; fragments of the lower jaw of a young individual containing the last temporary and the first permanent true molar; three upper and two lower incisors. Also, besides a quart measure full of small fragments of vertebræ, and of bones of the extremities, the following:—fifteen mutilated vertebræ; part of a scapula; two humeri embedded in ferruginous sand, and measuring seven inches in length; lower extremity of another humerus, one inch and a half in transverse diameter; two olecranon processes; several carpal bones; a pair of co-ossified metacarpals, three inches long and one inch wide at the base; several isolated metacarpals, and halves of metatarsals; four first phalanges, two second, and two last ones; portions of two hip bones; extremities of four femora; one patella; two heads of tibiæ, measuring one inch and three quarters in transverse diameter; distal end of another tibia; two calcanea, two and three quarter inches long; one astragalus, and several other tarsal bones. All these specimens were obtained by Dr. Edward Kittoe, from the lead crevices of the cliff limestone rocks of Galena, Illinois, and have been presented to the Academy of Natural Sciences.

13. A fragment of the lower jaw, of a young animal, containing the last temporary molar unworn. The first permanent true molar had not yet commenced to protrude. The specimen was from Augusta Co., Virginia.



T. Sinclair lith.

1, Megalonyx Jeffersonii, Harlan. 2-7, Dicotyles compressus, Leidy
8-11 Saurocephalus lanciformis Harlan. 12-15, S. Leanus, Harlan

14. The half of a lower jaw, the upper jaw with the molar teeth, and other fragments, belonging to several individuals; found by Dr. Foster, in Iowa, and now in possession of Prof. Wyman, who proposes shortly to give a more complete account of them, together with some other interesting fossils discovered in association.

REFERENCES TO PLATE 6.

Figure 2. Series of upper molars of the extinct peccary, *Dicotyles compressus*. From a specimen discovered in Iowa. Fig. 3. Series of lower molars from the same individual. Figs. 4, 5. Upper incisors of *D. compressus*. Figs. 6, 7. Inferior incisors of *D. compressus*.

ARTICLE IX.

REMARKS ON THE STRUCTURE OF THE FEET OF MEGALONYX.

BY JOSEPH LEIDY, M. D.

[Read Dec. 19, 1856.]

In the Smithsonian Contributions to Knowledge entitled "A Memoir on the Extinct Sloth Tribe of North America," I attributed five toes to the hinder-feet, as well as to the fore-feet of the *Megalonyx*:—a greater number than is known to belong to any other genus of the Gravigrada. At the time of writing the memoir, I had only had the opportunity of seeing the second, fourth, and fifth metatarsal bones of the *Megalonyx*. Prof. M. Tuomey recently presented to the Academy of Natural Sciences, a collection of bones of the Megalonyx, discovered in a cave in the northern part of Alabama. In this collection there is a complete series of metatarsals, as represented in fig. 1, plate 6, except the first one, or that belonging to the inner side of the foot.

The middle metatarsal bone is the shortest of the outer four, but it is much more robust in its proportions transversely and vertically, in accordance with the great size and strength of the middle toe. Its shaft is quadrate, but is so short as to appear to be formed simply by the conjunction of the carpal and phalangial extremities. The latter extremity is composed of three vertically convex lobes of which the median one is three and a quarter inches in depth. The carpal articular surface extends the entire depth of the corresponding extremity, and is quadrate and moderately concave. The articulation for the base of the second metatarsal bone, is a convex, oval surface, supported at the upper angle upon a prominent tuberosity. In a corresponding position, externally there is a rounded concave surface for articulation with the base of the third metatarsal bone.

The last metatarsal bone of the left foot presents a remarkable variation from that of the one figured; the interval between the shaft and long basal process being filled up, so that the bone is, in this specimen, a thick triangular plate with the carpal and fourth metatarsal articular surfaces placed on each side of its inner angle.

The measurement in length of the four metatarsals represented, is 3 inches for the second, 2½ for the third, 4½ for the fourth, and 5 for the fifth.

Besides the bones mentioned, the collection of Prof. Tuomey contains an atlas, axis, and three other cervical vertebræ; fragments of ribs and dorsal and lumbar vertebræ; six caudal vertebræ; one calcaneum, one astragalus, one cuneiform, and two cuboid bones; a first and second median phalanx of the hind foot, co-ossified as described in the memoir above mentioned, and a first median phalanx isolated; a first and second phalanx of the fourth toe; two median metatarpals, one fifth metacarpal, and the first and second phalanges of the median and fourth toes of the fore foot.

Mingled with these remains of the *Megalonyx*, there was a humerus of a large wolf, and the same bone of a species of deer.

REFERENCE TO PLATE 6.

Fig. 1. The second to the fifth metatarsal bone inclusive of the right hind foot of *Megalonyx Jeffersonii*, commencing from the right d, b, c, a. One half the size of nature.

REFERENCE TO PLATES IV, V, VI.

Plate IV. Fig. 1. Skull of *Trichecus rosmarus fossilis*, from the coast of New Jersey; reduced one half. Fig. 2. Under view of a facial fragment of the skull of *Trichecus rosmarus fossilis*, also found on the coast of New Jersey; reduced one half.

Plate V. Fig. 1. Under view of the same specimen represented in plate IV, figure 1; reduced one half.

Fig. 2. Tooth of *Cochliodus nitidus;* natural size. Figs. 3—16. Teeth of *Cochliodus occidentalis.* Fig. 17. Tooth of *Cochliodus latus.*

Fig. 18. Tooth of *Helodus gibbus.*

Fig. 19. Tooth of *Chomatodus venustus*, upper view; enlarged three diameters. Fig. 20. Profile section of the tooth at the middle; three diameters. Fig. 21. Profile section at one side; three diameters. Fig. 22. Tooth of *Chomatodus obscurus;* natural size. Fig. 23. Profile section of the same tooth.

Figs. 24 and 25. Posterior and anterior view of the portion of a tooth of *Palaeobatis insignis;* enlarged two diameters. Fig. 26. Profile section of the same tooth; enlarged four diameters.

Figs. 27 and 28. Internal and external view of the tooth of *Ctenoptychius digitatus;* natural size. Fig. 29. Profile section of the same tooth.

Fig. 30. A flat pointed bone (?), found in company with the preceding teeth; in the carboniferous limestone of Illinois.

Plate VI. Fig. 1, d, c, b, a. The second to the fifth metatarsals, of the right hind foot of *Megalonyx Jeffersonii;* reduced one half.

Figs. 2, 3. Superior and inferior molar teeth of the right side, of *Dicotyles compressus.* Figs. 4 and 5, superior first and second incisors. Figs. 6 and 7, inferior first and second incisors.

Fig. 8. Left upper maxillary bone of *Saurocephalus lanciformis.* Fig. 9. Tooth of do.; magnified three diameters. Figs. 10, 11. Transverse sectional outlines of the crown and fang; three diameters. Fig. 12. Left maxillary (a,) and premaxillary (b,) of *S. Leanus.* Fig. 13. Inner view of the same specimen. Fig. 14. Left dental bone of *S. Leanus.* Fig. 15. Outline of a superior tooth of do.; magnified four diameters.

ARTICLE X.

NOTES ON CERTAIN MODES OF MEASURING MINUTE INTERVALS OF TIME.

BY J. C. ADAMSON, D. D.

[Read, February 6, 1857.]

It has become necessary to devise means of estimating minute intervals of time for two purposes. Of these purposes, one is, to ascertain the absolute length of an interval merely, or the absolute duration of a transient phenomenon, such as the passing of an electric current over a given extent of wire. The phenomena to which contrivances for this end have been applied, are such as are observable by the sense of sight alone. The observation of the interval is necessarily independent of the observer's internal mechanism, or habit, or *personal equation* as it is termed; and it is not a matter of primary importance to settle, or posit in actual time, the beginning or the end of the phenomenon.

The other purpose in measuring minute intervals of time, is to determine the fraction of a second occurring between two phenomena, one of which is fixed in time, such as the beat of a clock, or the contact of its hand with a point, and the other is an incident occupying no assignable time, such as the contact of a star with a micrometer wire, or with the limb of the moon, &c. In this case the action of a single sense, or of more than one, may be put in requisition. There are two phenomena, each of which has to be posited in time; the interval between them, as to its length, depending on the relation of both to absolute time. The observation of the interval may or must be affected by the observer's mechanism of sense, or habit, or by his personal equation, in regard to both phenomena. The astronomer has therefore forms of mechanism of three very different orders to attend to. There is, first, his own internally; next that of his time-measurers; and lastly, that of the universe, which he aims at illustrating. The two former he has to study by comparison with the last, which alone affords him true position and dimension in time; while all his conclusions in regard to it, are dependent on his right use of the others. The in-

fluence of the first, or the special constitution of the observer, was, until lately, almost entirely overlooked. The improvement, however, of instrumental measures in these later times has brought it prominently forward, as one of the most influential elements affecting the accuracy of astronomical observations. Every thing, therefore, which can reduce the amount of uncertainty due to it, or which tends to eliminate altogether its effects, becomes of high importance.

To understand the limit to which uncertainty in observations may be diminished, in so far as it is dependent on personal equations, requires that we should analyze sensation and thought in their relation to time. Every one feels that both are conditioned to time; or that the changes of sensation and of thought do require a certain duration, so that, though rapid compared with many phenomena, they are slow compared with others. We must not confound the special differences in character, nor the physical distances in position, between the objects imaged by the presentative faculty of the mind, with the length of interval in time expended in the change. When our thoughts go from a line in the Odyssey to the ocean which it recalls, or from the diamond spark on a beetle's wing-case to the twinkling of the pole star, thought is not more rapid than in proceeding from the beetle's limb to his eye, or from one word to the adjoining one. The real velocity of thought consists in the number of changes which are possible in a given time. It does not follow from any thing known a priori as to a spiritual nature, that this velocity should be indefinite; or, in different orders of spiritual nature, should not follow different defining laws; except that in the highest or creative intelligence, thought must be timeless, absolute and without succession. It belongs to our connexion with material things, that thought should have a relation to them and to their movements, for these movements constitute and measure time to us. Whether changes of thought, or changes of sensation, be the more rapid, is an interesting question. The comparisons which it suggests, show plainly the fact, that thought is conditioned to time, and serve also, to some extent, to determine the condition.

An impression of light occurring oftener than ten (10) times in a second of time, will to most eyes appear a continuous illumination. Impulses of sound beyond (16) sixteen in a second, will not generally be apprehended as distinct sounds. In regard to neither sense do I, of course, speak at present of the physical vibrations which put our organs into a sentient state, but of the continuance of that state when it is produced in the sentient organ. It is the termination of this state which constitutes the change of sensation. The number of such changes in a given time is its velocity. We reckon therefore that the relative velocities in regard to sensations in the eye and the ear, are as 10 : 16. No ideas in the mind are perhaps simpler than those of number, in whatever mode, or under what-

ever form, they may, in different individuals, or at different times in the same individual, be presented to the intellect; and in no case is thought likely to be more rapid than in proceeding from number to number, so as to consider each individually, and not bring them together in groups or systems. Now if any one endeavours to put a series of them through the mind, under this restriction of their being separate and individual as mental conceptions, he will probably find that he cannot do so faster than his changes in sensation occur. He will find that, in regard to impulses of sound, he cannot number accurately those which the ear perceives to be distinct. If they amount, for instance, to 12 in the second, he will not, by the mind's effort only, ascertain confidently that such is the fact. If the impulses be reduced to 10 in the second, which would correspond with the limit of duration as to time in regard to the eye's sensations, counting of them with confident accuracy will be found to be difficult. It may be presumed that no one will, even with long continued trial and practice, be able to go beyond this. We may on the whole, therefore, conclude that while changes of sensation do not occur oftener, than at the rate of one in $\frac{1}{16}$ of a second, changes of thought, or of will, require about double the time of such perceptions. Thus there are insuperable limits to accuracy of observation, through means of the senses and the will alone.

Human physiology, therefore, comes here in contact with practical astronomy. In the observations of that science the circumstances of this kind which influence their accuracy may be complicated to a considerable degree. There may be acts of will, of judgment, and of sensation, all occupying time; and capable of variation in that respect in correspondence with training, habit, or constitutional peculiarities. Two observers watching the same phenomenon, such as the meridian passage of a star, will, though in circumstances which, in respect to the phenomenon itself, are identical, differ in their estimate of the time of its occurrence. This difference may originate from either or from both of two classes of incidents. There may be a difference in absolute time, in the completion of the contact to them individually, or in the sensation of the phenomenon; or there may be a difference in the accessary circumstances, by which the sensation of the phenomenon is referred to a known instant in time. It is probable that individuals differ in regard to both these classes of incidents; but that difference will be more conspicuous and important in regard to the second rather than the first. Differences in respect to the sensation of the phenomenon, though probably the less important, are more completely beyond control by any helps or modifications; and where such exist permanently, they will constitute the *proper* personal equations of individual observers, admitting of no modification but that of being, when ascertained, kept by training and habit, in a condition as uniform as possible in amount.

Art has more control over the accessary movements by which the phenomenon is referred to a known instant. In this class of incidents, either the same organs may be employed throughout the whole observation, or different organs may be called into exercise. The employment of one sense, or of the eye alone, has not been greatly practised, nor have the results been satisfactory. It was proposed by Breguet of Paris, about thirty years ago, to introduce a time-movement into the field of view of the telescope, to be studied simultaneously with following the course of the star. To this, Brewster objected, that when attention was concentrated on one object, the other would disappear from view. This would generally be the case, and to a person trained to other modes of observing, the difficulty might be perplexing. But if the habit had been acquired of watching the contact, and then instantly by an immediately subsequent effort, catching the indication of time, this would have required an interval, as all such operations must do, but all that would be needful for accuracy is, that personal training should render the interval constant, and that it be allowed for. It might in making an attempt to observe in this way, be found suitable that the time-movement were brought into the field of view by reflection only.

The more common modes of observation, call for the exercise of more than one organ. Of these modes the older employed seeing and hearing; the practice being to count seconds as beat on a clock, up to that immediately preceding the expected contact, and then to estimate the position in time of the phenomenon of contact between the beat last heard and the succeeding one. The estimate in this case might have been rendered dependent on the habit, reduced to regularity by training, of repeating in thought the numbers up to eight or to ten; and various modes of giving accuracy to the estimate might have been introduced. But the whole process will probably be everywhere superseded by the mode introduced and recommended by our American astronomers, by which these accessary movements are considerably simplified.

In this case we employ the eye to watch the phenomenon, and some other organ, such as the finger, to give a signal; the signal being a permanent mark by electric influence on some apparatus for time-movement, so that the instant of apprehended contact is registered on the apparatus. This improvement relieves the observer from all necessity of attending in thought to intervals of time. It leaves him free to watch for the single phenomenon of contact. Himself and the earth's rotation are now the only elements concerned in the proceeding. In the case of there being several parallel wires in the field of view, no process need interfere to direct his attention from the successive contacts.

If we bring under consideration now the condition of the observer, we shall find two circumstances remaining which will still give origin to differences of result in different individuals, constituting personal equations to be investigated and taken into account in re-

ductions. There is the sensation process of apprehending the fact of contact, and there is the complex process of will and of muscular effort, in giving the signal. All these three processes ought to be absolutely co-instantaneous. This, however, as we have seen, is impossible; for the three must be historically consecutive; and our only resource to secure accuracy must be to render the intervals of time regular in extent, and ascertained in quantity. The sensation process, or the apprehension, in the mind, of the contact or bisection will, in this case, differ somewhat in its circumstances from those which characterized it under former modes of observation. When the observer was counting the second-beats of a clock, he could retain mutually an apprehension of the space passed over by the star during the interval of the two consecutive beats, between which the contact or bisection happened, and of the relative size of the divisions before and after into which the wire, or the star in contact with it, divided that space; or, in counting minute portions of a second, he might both count onwards from the preceding beat to the contact, and thence onwards afresh to the subsequent one. In such ways he might get the phenomenon posited with some degree of accuracy between the two. In the more recent mode of proceeding, however, there can be no such resource. The instant of bisection must be the instant of signal. If the bisection passes over, the observation is lost, except a time-estimating process in the mind be employed to correct the instant marked on the time-movement apparatus, which it would be scarcely suitable to employ except in singular instances. The process of observation in general, with all probability, will be, that the observer "wills" the muscular movements which are to give the time signal of bisection, before the bisection is actually perfect, so as to allow for the interval which these movements need. It may be, that such almost unconscious anticipations of events, or mental movements of an analogous order, are mainly the cause of those differences in the results of observation, which may be termed *real* or proper personal equations as formerly alluded to.

Here a principle may be noticed, which is perhaps capable of being introduced with the effect of determining the relative perfectness of the bisections, at the instant when the will acts to give the signal. This consists, in the definiteness of the last impression on an organ of sense, when, for a time, no other is permitted to interfere with it. Attention to this circumstance explains some interesting phenomena. Nature provides examples of it in two modes. When we gaze at any rapidly moving stream or succession of bodies, the appearance to the eye, provided its axis of vision remain fixed, will be confused, or be merely a formless succession of uniform or slightly varying shades. It is known however that if such a stream, as, for example, if a shower of the drops of falling quick-silver in the dark be revealed by the quick and instantaneous flash of an electric spark, then will every mass in its proper shape appear to be suspended unmoved in the air. A similar effect is

produced when the eye is fixed on a swiftly revolving fly wheel, provided the axis of vision follow for an instant the ascent or descent of the rim. It will thus happen that the ends of the arms are seen momentarily with considerable distinctness, so as to give to the revolution an appearance of irregularity, which does not belong to it. In observing steadily the current of a river, there is a natural tendency in the axis of vision to follow bubbles, patches of foam, or other objects floating with the stream, against which it requires an effort constantly repeated, to replace the axis in the same direction. This adds to the variety and life-like motion of the stream. If attention be given to a cascade, with the axis of vision directed towards its summit, there is the same natural tendency to let it descend with the masses of falling water, which are thus revealed individually in their proper form and dimensions, all disappearing as the eye glances upward again. Hence there is an apparently capricious variation of appearance in these and some analogous instances, which never can be caught in painting, for all representations of them must correspond to their aspect when the eye-axis is absolutely fixed, or when the moving masses are not in its focus of vision. The effect is obviously traceable to the longer duration given to one impression in the eye, while its axis follows the movement, or to its relief from a succeeding impression coming on to interfere with one already received.

Another method of producing the same effect is by winking, or by rapid closing of the eyelid. The circumstances already mentioned as affecting the appearance of a waterfall, or other quick movements of masses in motion, are sometimes due to this influence. By thus preventing a subsequent impression from over-lapping and confusing one already received, an image before the mind is for a time stored up there, to be contemplated by it. If in marking the instant of bisection, by means of a signal given to a time-movement, it could be so arranged that the image in the state of bisection were instantly covered, then the examination of this last impression received from it, would decide as to the completeness of the bisection when the signal was given. This closing off of the image might be produced by the same finger-movement which sent the signal on to the time piece; or the eyelid and the finger might be trained to act in conjunction. Trial will readily show that different portions of the muscular frame act with sympathetic readiness under the same movement of the will.

As to the time-movement to which, in such a mode of proceeding, a signal is to be given, it seems to have been assumed that there is a necessity for a perfectly uniform motion, or one such that signals given after equal times were found to be separated by equal spaces on the dial-face, or on whatever surface may receive the mark of the signal. This uniformity is evidently by no means indispensable. It is enough that the movement take place under some known law, so that from the measurement or register of the spaces passed over by the

movement, the times may be deduced. Nothing offers itself so readily for this purpose as the motion of the pendulum of a time piece. The arc of movement corresponding to one second is sufficiently uniform in its amplitude, and is extensive enough to admit of being divided into spaces affording probably as minute and as correct measures of the fractions of a second as our physiological constitution will admit of our taking into account in practical operations. To render it available for this purpose, a metallic arc concentric with the arc of vibration is to be placed exactly under the pendulum, and resting on glass, so as to be in a state of electric insulation. A fine point in the axis of the pendulum vibrating above this metallic arc, will communicate or receive slight galvanic discharges, marking the period during the vibration at which, by means of the common apparatus recommended for such purposes, a galvanic contact is effected. If, between the metallic arc and the pendulum point, there be interposed a film or riband of paper chemically prepared to receive and retain a mark from the passing galvanic influence, the position of this mark will indicate the instant of the signal, measured from the beginning of the vibration. The paper may be ruled with parallel lines transverse to the movement of the vibrating point, so as either to mark equal subdivisions of the arc, from which the times may be deduced, or so as at once to present intervals corresponding to equal divisions of time. A time-movement of any character drawing this paper along, will secure the proper record of the signals made at the occurrence of the observed phenomena. It may be a subject of inquiry whether the galvanic influence passing between the metallic arc and the vibrating point, would not tend to disturb the rate of the clock. The same objection, if sustainable, will affect all time-movements on which signals are impressed by galvanic influence. The extent to which this tends to interfere with absolute accuracy, may be the subject of interesting experiment, if the case requires it. In the case of the pendulum it will be advisable to extend the metallic arc to some distance beyond the amplitude of the vibration. With this precaution to compensate for irregularity of force at the ends of the arc, if such should be apprehended, and having the electric tension of a low rate, it is not probable that its introduction, in giving a signal, would have any sensible effect in the rate of the clock. The effect, if capable of being recognised, would be estimated as a correction.

It may be worth inquiry, whether celestial phenomena may not, in certain cases, be made to give of themselves permanent signals of the time of this occurrence, so as to reduce such observations to mere linear measurements, or to coincidences with measures already made and marked. This would be accomplished if a star's pencil of rays could trace the star's path across the field of view in a permanent form upon a surface. Photography has reached such a condition as apparently to bring this within our power. The preparation composed of albumen, iodide of iron, alcohol and acetic acid, has been found

so sensible that it received a legible impression from a printed surface during the flash of an electric spark. This should give sensibility enough for the concentrated light of a star from a large object glass. By having, therefore, a surface of this kind moving with a defined velocity transversely to the direction of the star's path transiting the field of view, we should obtain the recorded signals, which we want. The requisite arrangements for such an effect, with reference to the eye piece and the transit wires, are sufficiently obvious. Determinate distances along the prepared sensitive surface in the direction of its motion would mark the times. The star's motion would be indicated by a dark line crossing this surface. If the transit wires were illuminated, they would appear on the surface as dark lines, parallel to the direction of its motion. The line of the star's motion would cross these obliquely, at an angle determined by the velocity of movement given to the surface. The effect of inflection at the edges of the transit wires, and of imperfection of focus in the instrument, might render these lines somewhat broad and indistinct as to their lateral boundaries; but points of coincidence in their axes would probably be determinable, with considerable precision. If the transit wires were not illuminated, they would then produce an interruption, or a difference of shade, in the line of the star's path, which might serve perhaps better to mark the instants of contact. A suitable degree of artistic skill may make lines on the prepared surface itself to become substitutes for the transit wires. With the employment of a good object glass alone, and with means of directing its line of collimation, in combination with arrangements of the sort now alluded to, it does not appear difficult to substitute the astronomical clock or chronometer, for the living observer, and to reduce almost indefinitely the causes of uncertainty in respect to siderial astronomy. To apply the same principle to the movements of the sun and moon would require some farther modifications, but most inquiries with regard to the movements of the planets and of conspicuous or solitary stars, would be facilitated and rendered more precise if these suggestions can be carried out.

ARTICLE XI.

DELLA CORRELAZIONE DELLE FORZE CHIMICHE COLLA RIFRANGIBILITA DELLE IRRADIAZIONI; DI ZANTEDESCHI.

ESPERIMENTI ESEGUITI COL CALORICO SOLARE.

Read November 20th, 1857.

Queste Ricerche furono incominciate il giorno 22 Agosto, del 1857, nel Gabinetto di Fisica dell' I. R. Universita di Padova dalle ore 11 ant. alle 2 pom., con la collaborazione dell' Assistente alla mia Cattedra sig. Dott. Luigi Burlinetto; e furono proseguite nei giorni successivi come diremo.

Gli apparati che ho impiegato furono i seguenti:

1°. Un perfetto eliostata di Silbermann maggiore, che io aveva ritirato dal distinto Ottico di Parigi il sig. Dubosq-Soleil per uso di questo Gabinetto di Fisica. Esso in tre ore di esperienze non ci presentò veruno spostamento sensibile.

2°. Un tubo comune da porta-luce universale munito di una piastra mobile, portante fori circolari di diverso diametro. Ho impiegato quello che aveva il diametro di 16 millimetri. Questo tubo terminava in una giunta di altro tubo minore, lungo circa un decimetro, e del diametro di tre centimetri.

3°. Un piano mobile di noce, colorito in nero, insisteva verticalmente sopra una base, e mediante una vite micrometrica poteva essere postato innanzi o indietro, secondo il bisogno. Esso era munito di fori circolari di diverso diametro, disposti orizzontalmente sulla medessima retta, e munsti di dischi mobili di metallo da potersi chiudere ed aprire a piacimento. Quello che io trascelsi in queste investigazioni aveva il diametro di 15 millimetri.

4°. Una pila termo-elettrica di Gurjon, col moltiplicatore a filo corto, era l' apparato misuratore delle azioni calorifiche solari.

L' estremità del piccolo tubo addizionale al porta-luce era distante dal foro del piano di riparo 38 centimetri, e la pila era distante da questo secondo foro un solo centimetro.

Collocato l' ago del galvanometro perfettamente a zero, fu stabilita la comunicazione fra la pila e la luce solare riflessa dallo specchio di Silbermann, e la deviazione dell' ago galvanometrico si portò a 20° ad indice fisso. Tolta la comunicazione del raggio solare, l' ago si ridusse successivamente a 0°.

Eseguito questo esperimento preparatorio, io applicai in seguito al tubo addizionale del porta-luce i vetri colorati dell' apparato termo-moltiplicatore di Rumkorff coll' ordine seguente: rosso, aranciato, giallo, verde, azzurro, indaco e violetto; ed ebbi i risultamenti che quì sotto sono presentati:

Senza vetro, ...	deviazione	20°
Col vetro rosso . . .	"	5°
" aranciato, . . .	"	9° 30
" giallo, . . .	"	9° 30
" verde, . . .	"	0°
" azzurro, . . .	"	6°
" indaco, . . .	"	12°
" violetto, . . .	"	8° 30

Queste deviazioni furono sempre ad indice fisso, ed i vetri impiegati si trovarono della stessa precisa grossezza di un millimetro.

Confrontando questi risultamenti ottenuti, si riscontrano due massimi dell' azione calorifica; l' uno nell aranciato e nel giallo, che decresce dal lato del rosso, e che si estingue nel verde; l' altro massimo é nell' indaco, che decresce più dal lato dell' azzurro, che da quello del violetto.

Secondo queste sperienze, sarebbero due gli spettri calorifici, come sono due gli spettri luminosi originali da me discoperti: rosso e giallo, violetto ed azzurro. Io non presento questi risultamenti come assoluti, ma soltanto come relativi ai vetri che ho impiegato. Chiederò al valente mecanico Rumkorff da quale officina abbia egli ritirato i vetri colorati del suo apparato termo-moltiplicatore, e con quali ossidi metallici sieno stati colorati, perchè sono d' avviso che in questi effetti intervenga anche la natura del corpo diatermano.

Non sarà inutile registrare il motivo della pratica seguita di riparare le finestre con tende o veli verdi, come pure l' occhio con vetri verdi, precipuamente nell' estiva stagione. Il potere diatermano fu da me trovato, nei limiti dei mezzi da me impiegati, nullo col vetro verde. Si scorge ancora dèi risultamenti esposti non essere intieramente oltimo il consiglio di alcuni Oculisti, quello cioè di riparare l' occhio con vetri azzurri e tinti in indaco, perchè in quest' ultimo riscontrai sempre il massimo dell' azione calorifica.

Una seconda serie di esperimenti è stata eseguita applicando al tubo del porta-luce un vetro rovo-cupo dell' apparato termo-elettrico di Gurjon. Colla interposizione di questo

vetro la deviazione dell' ago da 20° si porto a 3°. Ritenuta questa deviazione come costante, si è applicato al foro del piano di riparo un vetro rosso dell' apparato di Rumkorff, e la de viazione divenne di 2° 30′. Sostituito a questo vetro rosso di Rumkorff sul piano di riparo i seguenti per ordine fermo però nel tubo del porta-luce il vetro rosso di Gurjon, si ebbero i risultamenti quì sotto indicati:

Col vetro	azzurro	R. . . .	deviazione, 1°
"	violetto	R. . . .	" 2°
"	indaco	R. . . .	" 2°
"	verde	R. . . .	" 0°
"	aranciato	R. . . .	" 2°
"	giallo	R. . . .	" 2°

Susseguentamente a questi esperimente ne furono eseguiti degli altri nel giorno 23 Agosto del 1857 alle medesime ore.

Applicato al tubo del porta-luce un vetro giallo dell' apparato termo-elettrico di Gurjon, la deviazione dell' ago da 20° si ridusse a 6°.

Col vetro giallo di Rumkorff, applicato al piano di riparo, la deviazione si portò a 3°.

Col vetro verde di Rumkorff la deviazione fu pressochè 0°; o tuttò al più, misurata con eccesso di scrupolo non giunse neppure a 0° 15′.

Col vetro azzurro di Rumkorff la deviazione fu di 2°.

Altri esperimenti furono eseguiti colla luce solare nel giorno 25 di Agosto 1857, ritenute le distanze delle parti dell' apparato come nei precedenti esperimenti.

La deviazione dell' ago, senza l' interposizione di alcun vetro, fu di 22°; ma applicati al piano di riparo i vetri colorati di Rumkorff coll' ordine seguente si ebbe:

Col. vetro	rosso	R.	7°
"	aranciato	R.	12°
"	giallo	R.	12°
"	verde	R.	0°
"	azzurro	R.	9° 30
"	indaco	R.	15°
"	violetto	R.	11° 30

Ancor qui si ebbero risultamenti che quadrano perfettamente con quelli ottenuti regli sperimenti del giorno 23 Agosto 1857.

Noterò solo, che nel piano di riparo avendo, in luogo del vetro verde di Rumkorff, applicato il vetro verde-chiaro di Gurjon, si ebbe una deviazione di 2°.

Questo fatto dimostra in ogni caso, che il vetro verde è meno diatermano degli altri vetri colorati.

Altri sperimenti furono in seguito eseguiti con due vetri colorati.

Applicato al tubo del porta-luce il vetro azzurro di Gurjon la deviazone da 22° si ridusse a 9°.

Fermo questo vetro al porta-luce, furono applicati al foro del piano di riparo.

Il vetro azzurro	R.	5°
" violetto	R.	5° 15
" giallo	R.	4° 30
" rosso	R.	3° 30
" verde	R.	0°

La natura, quando presenta dei fenomeni che sembrano straordinarj, dev' essere consultata ed interrogata con tutta la diligenza possibile. Fu per questo che ho ripetuto le sperienze che seguono.

Applicato al foro del porta-luce il vetro giallo di Gurjon, la deviazione si portò a 9° 15.

Appresso, al foro del piano di riparo furono applicati:

Il vetro giallo	R.	4° 45
" rosso	R.	2°
" azzurro	R.	3°
" violetto	R.	3° 15

Dal complesso di questi esperimenti, eseguiti con doppj vetri, risulta che il potere diatermano segue poi da vicino il grado di rifrangibilita del raggio luminoso colorato, del quale il corpo diafano è dotato; e dal complesso degli sperimenti eseguiti con un solo vetro emerge che si dà luce senza calorico sensibile a' nostri apparati, come da gran tempo si conosce che si dà calorico senza luce. La natura mi diede una riprova di quanto essa mi aveva mostrato al polo negativo dell' elettromotore, dove io avea riscontrato luce fredda; come avea pure riscontrato al polo positivo calorico senza luce. Queste due forme si trovano bensì per ordinavio collegate specialmente nelle loro irradiazioni di eguale o di pressochè eguale rifrangibilità; ma possono ancora presentarsi separate.—La Fotografìa ha un ampio campo di nuove investigazioni sopra i vetri colorati de differenti ossidi metallici; ed il Naturalista ha motivo di meditare perchè la tinta verde sia predominante nel regno vegetale, mentre in generale è esclusa dal regno animale.

ESPERIMENTI ESEGUITI CON SORGENTI CALORIFICHE ARTIFICIALI.

Nel giorno 25 Agosto, 1857, disposta una lampada ad alcool col platino incandescente alla distanza dal foro del piano di riparo sei centimetri, e la pila alla distanza dallo stesso un centimetro, si ebbe la deviazione di 18°.

Applicato al foro del piano di riparo il vetro rosso di Rumkorff, la deviazione fu di 5°.

Si ebbe la cautela di ridurre fra l' uno e l' altro esperimento l' ago a 18°.

Col vetro aranciato	R.,	5°
" giallo	R.,	5°
" verde	R.,	5°
" azzurro	R.,	5°
" indaco	R.,	8°
" violetto,	R.,	7° 30

Portata la fiamma alla distanza di 0^m, 12, la deviazione fu di 5°.

Col vetro rosso	R.,	2°
" aranciato	R.,	2°
" giallo	R.,	2°
" verde	R.,	2°
" azzurro	R.,	2°
" indaco	R.,	2° 30
" violetto	R.,	2°

Colla semplice fiamma ad alcool, ritenuta alla distanza di dodici centimetri, la deviazione fu di 3°.

Col vetro rosso	R.,	0° 30
" verde	R.,	0° 30
" indaco	R.,	0° 50

Si ebbe la cura di tenere difeso il vetro dalle sorgenti calorifiche mediante un riparo di cartone, onde non venisse riscaldato, e che tutto l'effetto, per quanto era possibile, fosse dalle irradiazioni immediate; e ciò fu eseguito fra l' uno e l' altro esperimento. Si deve avvertire che vi fu un movimento istantaneo dell' ago, ma che il massimo della deviazione non si ebbe che sucessivamente. L' elemento del tempo necessario ci fa sospettare che la deviazione dell' ago sia in parte dovuta alle irradiazioni immediate, ed in parte al calorico della temperatura del vetro. Bisogna nondimeno confessare che vi è l' inerzia dell' ago, che da una debole forza non può essere portato sull' istante alla massima deviazione. In favore di questa sentenza sta l'osservazione, che anche senza l'interposizione del vetro giunge al massimo della deviazione per impulsi ripetuti successivi.

Da tutti questi esperimenti, eseguiti col calorico terrestre, appare chiara la differenza di comportarsi del vetro verde con queste irradiazioni artificiali, in confronto delle irradiazioni solari. Questa differenza non può essere certo attribuita a maggiore energía delle sorgenti artificiali impiegate in confronto della solare, avvegnachè la deviazione in questo caso sia stata di 18°, e nell' altro caso di 20°, e perfino di 22°. Pare che v' intervenga la natura del corpo irradiante, e che le irradiazioni incontrino resistenze differenti, a seconda delle sorgenti dalle quali emanano.

Rimane tuttavia costante il fatto, che per li vetri di riparo degli occhi è da preferirsi il vetro verde ai vetri azzurro, indaco e violetto.

Parmi ancora potersi raccogliere che gli spettri calorifici delle diverse sorgenti diversi-

fichino assaissimo fra di loro nella quantità e qualità delle loro irradiazioni. Dal confronto dei risultamenti ottenuti con gli stessi vetri, è veso evidente, che per la sorgente dell' alcool e del platino incandescenti le irradiazioni delle rifrangibilità che accompagnano il rosso, l' aranciato, il giallo, il verde l' azzurro sono le stesse in quantità; ma che sono maggiori quelle che accompagnano l' indaco e il violetto. Argomento è questo di profonde e sottili investigazioni. Bisognerebbe sottoporre all' esperienza tutti i corpi in combustione che si conoscono, impiegando diversi mezzi che si fornisce la scienza. Combustioni prodotte nell' arco luminoso di Volta; combustioni generale nell' ossigeno; nell' ossigeno e nell' idrogeno; nel cloro, per facere di altri mezzi de' quali ora sono in possesso i fisici ed i chimici.

ARTICLE XII.

GEOLOGICAL SKETCH OF THE ESTUARY AND FRESH WATER DEPOSIT OF THE BAD LANDS OF THE JUDITH, WITH SOME REMARKS UPON THE SURROUNDING FORMATIONS.

BY F. V. HAYDEN, M. D.

Read March 4th, 1859.

NEAR the mouth of the Judith River, not far from the sources of the Missouri, in Lat. 47½°, Lon. 109½°, is a wild, desolate and rugged region which I have called the "Bad Lands of the Judith," in contradistinction to those of White River. No portion of the Upper Missouri country exhibits the effects of erosion and denudation on so large a scale, and to add to the picturesque effect of the scenery, the variegated strata are distorted and folded in a wonderful manner by the action of the subterranean forces that have elevated the mountain masses in the vicinity. The surface of the country occupied by the deposit I am about to describe, is cut up into ravines and canons, with nearly vertical sides, rising to a height of 400 to 600 feet above the bed of the river, with scarcely a tree or a shrub to greet the eye of the explorer. A few scattering pines cap the summits of the hills and draw a scanty nourishment from a thin dry soil, but it may be regarded for the most part as an inaccessible desert suited only as a retreat for the buffalo and mountain sheep.

The area occupied by this peculiar basin I could not determine with precision, but have estimated it at about forty miles from east to west, and from fifteen to thirty from north to south, and it is separated into two nearly equal portions by the Missouri. The Judith River rises in the Judith Mountains, pursues a course nearly due north, for the most part through cretaceous strata, and empties into the Missouri in Lat. 48°, Lon. 106°. The Judith River forms the northern boundary of this basin. The Muscle Shell River also rises near the Judith Mountains, but takes a course a little east of north, flows through Cretaceous formation No. 4, and empties into the Missouri near Lat. 47½° and Lon. 108°.

That portion of the "Bad Lands" which is formed of the estuary deposit under consideration, lies between these two streams. About thirty miles north of the entrance of the Judith River into the Missouri, is the Bear's Paw Mountain, a small range, the highest peak of which is about 2000 feet in height. On the same side of the Missouri, and in nearly a north-easterly direction, are the Little Rocky Mountains; a range similar to the Bear's Paw, though apparently disconnected from it. On the south side of the Missouri, about fifteen miles south-west of the mouth of the Judith, the Square Buttes may be seen rising 400 or 500 feet above the surrounding prairie, the nearest upheaval of trappean rocks to the Missouri in this region. From thirty to fifty miles south, is quite an extensive range, called the Judith Mountains, which have not yet been explored geologically. Here comparatively small local upheavals seem to represent the dying out of the intense subterranean forces which uplifted the vast Rocky Mountain chain. It will be important to understand the geographical position of these mountains in order to fully appreciate the sources of the power which has disturbed the strata of the more recent fossiliferous rocks, a point which will be again referred to in this paper.

Lewis and Clarke in their interesting account of an expedition to the sources of the Missouri, give a brief but accurate description of the physical features of this remarkable region, but dwell more in detail on the picturesque portions near the "Stone Walls," which are composed of the basis strata upon which the estuary deposits of the "Bad Lands" of the Judith rest, which are doubtless of the age of Cretaceous formation No. 1, or Upper Jurassic. The Prince of Neuwied also notices this unique scenery, and in his folio atlas of Plates are some beautiful delineations of the external features of the country.*

On page 228, he says:—"Near Lewis and Clarke's Big Horn Island, we again saw most singular summits on the hills. Entire rows of extraordinary forms joined each other, and in the lateral valleys we had interesting glimpses of this remarkable scenery, as we were now approaching the most interesting part of the Mauvaises Terres. I have already described these mountains when speaking of the White Castles, but here they begin to be more continuous, with rough tops, isolated pillars, having flat slabs or balls, resembling mountain castles, fortresses, and the like, and they are more steep and naked at every step. Often one may plainly perceive hills or mountains that have evidently sunk into the marshy valley. Many strata are inclined at an angle of 30° to 60°, and others perfectly horizontal. The course of the Missouri among these mountains is pretty straight, only narrow plains or prairies covered with artemisia and the prickly bushes of the pulpy thorn, lie on its banks before the mountains, which frequently come very near the river, with large blocks of sandstone at their foot, between which fragments of selenite are seen.

* Travels in the interior of North America: By Maximilian, Prince of Wied, with a folio atlas of eighty-one elaborately coloured plates. English Edition.

It were to be wished that the geologist and the painter might devote a considerable time to examine this part of the country, step by step; they would furnish a work of the highest interest."

Again, in speaking of the sandstone (No. 1,) which forms the "Stone Walls," about thirty miles above the mouth of the Judith River, page 236: "This sandstone formation is the most striking when it forms the tops of more isolated mountains, separated by gentle valleys and ravines. Here on both sides of the river, the most strange forms are seen, and you may fancy that you see colonnades, small round pillars, with large globes or a flat slab at the top, little towers, pulpits, organs with their pipes, old ruins, fortresses, castles, churches with pointed towers, &c., &c.; almost every mountain bearing on its summit some similar structure."

Lieutenant Grover, United States Army, in his Report* to Governor Stevens, thus speaks of this region:—"On leaving camp to-day, we took leave for a while of many wild beauties of nature which lay scattered along the river in an ever-varying panorama, to take a view of the other side of the picture of Nature's wild deformities, a master-piece in its way. The Mauvaises Terres or Bad Lands which this section is very appropriately called, are characterized by a total absence of any thing which could by any possibility give pleasure to the eye or gratification to the mind, by any associations of utility. Not an island nor a shrub of any account—nothing but high bare piles of mud, towering up as high as they can stand, and crowding each other for room. The banks, varying from 200 to 300 feet in height, were of this nature on both sides of the river all day."

The external features of the country have thus been described with great accuracy and fulness, but none of these writers seem to have given us any clue to the geological age of these deposits. During the writer's explorations of this region in the summer of 1855, he observed the basin-like form of this deposit and the limited area which it occupied, also the difference in its lithological character from the Cretaceous strata which surrounded it, and the Miocene beds which reach their most northern limit, some distance below the mouth of the Muscle Shell River.

From a small collection of vertebrate fossils made at that time, and placed in the hands of Dr. Leidy for examination, he (Dr. L.) was inclined to the opinion that the deposit in which these remains were found was of the age of the Wealden of Europe. Many species of Molluscous fossils were also obtained, but as they seemed more allied to Tertiary than Wealden types, the evidence became conflicting in its character. I will, however, present all the facts as yet secured in regard to its age or position, leaving the final determination to be made after a more thorough and detailed exploration which I hope to accomplish during

* Pacific R. R. Report, Vol. I., page 492.

the coming season. The want of proper facilities for exploration, the wild and desolate character of the country, the numerous bands of roving Indians which were constantly wandering over this region on their predatory excursions, rendered it impossible for me to make any thing more than a mere superficial examination of this locality.

So intimately do the Estuary beds at the mouth of the Judith seem to be connected with Cretaceous Formation No. 1, that it will be important to present such facts as are known in regard to it; and, in order to show their true relations to other geological formations of the Upper Missouri, I will briefly review the boundaries of these formations as they are revealed along the Missouri River. At the mouth of the Platte River we have the limestones of the Upper Coal Measures with their characteristic fossils. Thirty miles west on the Platte, these limestones are succeeded by a coarse, friable, ferruginous sandstone of Cretaceous age. About twenty-five miles north of the mouth of the Platte, on the Missouri, these same limestones are succeeded by the same sandstone just mentioned, which sandstone extends up the river to a point about ten miles above the mouth of Big Sioux. The Cretaceous rocks of the Upper Missouri have been separated into five divisions upon lithological and palæontological grounds, and the sandstone formation at the mouth of Big Sioux and below, forms the type of No. 1. Nos. 2 and 3 are seen reposing upon No. 1 at the mouth of Big Sioux, and near the mouth of the Niobrara River, No. 4 appears upon the summits of the bluffs, surmounting No. 3. At the foot of the "Big Bend," No. 3 passes beneath the water level of the river, and is succeeded by No. 4, which occupies the country to Grand River, where No. 5 makes its appearance on the summits of the hills. Near the mouth of the Cannon Ball River, the Lignite Tertiary beds begin to overlap the Cretaceous strata, but do not entirely conceal them along the banks of the river until we reach "Square Buttes," about thirty miles below Fort Clarke. From this point to Milk River in Lat. 48°, Lon. 106°, only the Miocene beds of the Great Lignite basin are exposed. The country in the vicinity of the mouth of the Yellow Stone River is covered by the Tertiary beds of the Lignite basin alone, containing their peculiar Fauna and Flora. The Tertiary beds continue uninterrupted until we reach the mouth of Milk River, where, by a reversed dip of the strata, the Cretaceous Formation rises to the surface from beneath the Tertiary. The Tertiary beds continue to overlap the Cretaceous, gradually thinning out upon the summits of the hills, until we reach the mouth of the Muscle Shell River, where the Cretaceous bed, No. 4, occupies the whole country. We thus see that in ascending the Missouri, the dip of the strata is north-west as far as Fort Union or some point in that vicinity, and on reaching Milk River we can very distinctly observe the dip south or south-east, by which the underlying Cretaceous beds are exposed. We can also note the basin-like form in which both Tertiary and Cretaceous rocks were deposited. Passing the mouth of the Muscle Shell we soon observe a somewhat remarkable bed rising

above the water level of the Missouri, near the mouth of Little Rocky Mountain Creek, which, from its lithological character and position, we have hitherto considered as belonging to Formation No. 1. It first makes its appearance as a seam of carbonaceous grit, of a dull reddish colour, very light and loose, like ashes, about one foot in thickness, separating No. 4 from a bed of sandstone beneath. As we ascend the river, a bed of sandstone rises rapidly above the water level, very variable in its lithological character. It is a yellowish gray friable sandstone, with small concretions of iron in yellow seams, layers of fine grained compact rock, turning reddish brown on exposure, also gray coarse grained concretions of sandstone. No fossils were found at this point, though some local seams of lignite occur, from one to two inches in thickness. Just below Ammel's Island, is an excellent exhibition of lignite and sand bed. The dip toward the south-east is at least ten feet to the mile.

Section of Beds in Descending Order.

1.—Cretaceous Formation, No. 4, with its usual lithological characters and a great profusion of fossils, *Ammonites, Baculites, Inoceramus, Ostrea, &c.*

2.—Lignite. 1st. Dark gritty shale, 4 inches. 2d. Excellent coal, bituminous, very hard, of a jet black colour, 1 inch. 3d. Coarse gritty lignite with small seams of carbon disseminated through it, which have a somewhat crystalline appearance, also considerable selenite in crystals, 5 inches.

3.—A variable sandstone, generally gray or ash-coloured, coarse grained and friable, with compact fine grained concretions. But throughout the bed are streaks or seams of ferruginous sand, some small globular masses of oxide of iron, and occasionally a local seam of lignite one or two inches in thickness, 50 to 80 feet.

About five miles above Ammel's Island, on the left bank of the Missouri, we have the following section descending:

1.—Cretaceous Formation, No. 4, capping the hills.

2.—1st. A seam of lignite, 10 inches. 2d. Stratum of clay, 15 inches. 3d. Earthy lignite, 12 inches.

3.—Grayish brown ferruginous sandstone, containing numerous fossil mollusca of undescribed species, 60 to 80 feet.*

4.—A bed of earthy lignite, rising just above the water's edge, 2 feet.

A little farther up the river, the lower bed of lignite becomes three feet in thickness, and of a purer quality. The bed of sandstone varies from 80 to 100 feet in thickness. Where No. 1 first appears near the mouth of Little Rocky Mountain Creek, the upper seam of lignite separates No. 4 from the bed of sandstone. Fifty miles farther up the river, the same lignite bed is overlaid by 40 to 60 feet of ferruginous arenaceous clays with concre-

* Nearly all the fossils collected from this bed were unfortunately lost.

tions of sandstone. The evidence is quite clear that the surface of No. 1 was much eroded prior to the deposition of No. 4. We also find that Formations Nos. 2 and 3 which are so well developed between the Great Bend and mouth of Big Sioux River, are entirely wanting in this region. Some uncharacteristic fragments of large bones were found in the debris near the water's edge, which appear to have been washed from No. 1, and doubtless belong to some immense saurian animal. Thus far up the river we have observed no indications of disturbance of strata by subterranean influences; but on reaching a point about five miles above Grand Island, a great thickness of rocks not before seen, is uplifted so as to exhibit the beds, inclining at every angle from a horizontal to a vertical position. The beds are composed of variegated sands, clays, and earthy lignite, and some of them are fully charged with organic remains. Toward the north the Bear's Paw and Little Rocky Mountains are full in view, rising out of the midst of the prairie, and toward the south we can see the Square Buttes, Judith, Girdle and Snowy Mountains, revealing at once the fact that the elevating forces, which uplifted these mountain peaks, disturbed the surrounding strata also.

The local sections already given, will show with sufficient clearness the lithological characters of the formation upon which the fresh water and estuary beds rest. A large number of local sections of the fresh water and estuary strata were taken at different points, and from them the following general section has been constructed; which, though future examination may modify to some extent, will be sufficiently accurate for our present purpose.

Section of Fresh Water and Estuary Deposits at the Mouth of the Judith River.

A	80 feet.	Yellow arenaceous marl passing downwards into gray grit, with seams of impure lignite; contains great numbers of a species of *Ostrea*, like *O. subtrigonalis* of the lignite basin, *Cyrena occidentalis*, *Melania convexa*, *Paludina Conradi*, *&c.* This bed caps the hills, and varies much in thickness.
B	10 feet.	Impure lignite, containing much sand; a few specimens of *Ostrea* like the above, with much silicified wood.
C	80 feet.	Alternations of sand and clay with particles of lignite; also reddish argillaceous concretions with a few saurian teeth and fresh water shells.
D	20 feet.	Alternate strata of sand and clay, with impure lignite and silicified wood, in a good state of preservation.
E	100 feet.	Variable bed, consisting of alternations of sand and clay, with large concretions, containing great numbers of *Melania*, *Paludina*, *Helix*, *Planorbis*, *Cyclas*, *&c.*, *&c.*, associated with saurian remains resembling the *Iguanodon* and *Megalosaurus*, and *Trionyx*, *&c.*
F	25 feet.	Alternations of impure lignite and yellowish brown clay, the latter containing great numbers of *Unio*, *Paludina*, *Melania*, *Cyclas*, and the fish remains referred by Dr. Leidy to the genus *Lepidotus*.
G	100 feet.	Ferruginous sand and clay, having in the upper part a seam 3 or 4 inches in thickness, composed mostly of shells of *Unio*. Lower part ferruginous, and coarse gray grit, with a seam near the base entirely composed of remains of *Unio Danai*, and *U. Deweyanus*, and *U. subspatulatus*.

All the beds vary in their lithological characters at different localities. At one point, bed A. contained large ledges of reddish concretionary sandstone, in which were most beautiful fragments of silicified wood, sometimes in nearly cylindrical masses, twelve inches in diameter and several feet in length. Near Cow Island vast quantities of shells occur in argillaceous and arenaceous concretions, in a very comminuted condition, as if they had been transported from a distance, very few of the fossils being sufficiently perfect to show clearly their specific characters. The beds of lignite in the Estuary deposit are very impure, containing a large proportion of coarse sand; they have ignited spontaneously in few localities. The lignite beds of the Marine Formation No. 1, are quite pure in many places, and exhibit the action of fire in the same manner as the lignite beds on the Yellow Stone and those on the Saskatchewan, so minutely described by Sir John Richardson.

About ten miles below the mouth of the Judith River, the Marine strata of No. 1, are seen to rise rapidly from beneath the Estuary and fresh water beds, and on reaching the mouth of the Judith we have the following vertical section of No. 1, the Estuary and fresh water beds only capping the hills and soon ceasing to appear.

1.—Yellowish and reddish, rather coarse grained sandstone, becoming deep red on exposure, containing *Inoceramus ventricosus, Mactra alta, Cardium speciosum, &c., &c.*—20 to 25 feet.

2.—Mixed pure and impure lignite—whole bed containing many crystals of selenite and a yellowish substance like sulphur. The masses of lignite when broken, reveal in considerable quantities small reddish crystalline fragments of a substance having the taste and appearance of rosin.—6 to 8 feet.

3.—Variable strata of drab clay, and gray sand and sandstone; upper part containing large numbers of *Ostrea glabra.* Near the middle, there are gray or ash-coloured clays, with very hard bluish gray granular silicious concretions, containing *Hetangia Americana, Panopœa occidentalis, Mactra formosa, &c.*—80 to 100 feet.

The above section will show very clearly both the lithological and palæontological differences in the two deposits under consideration. It will be seen that the beds represented by the last section contain only marine fossils, while the fresh water and estuary beds, with one exception, have furnished only terrestrial and fluviatile, with a few estuary shells. In regard to the age of the marine strata, it is still impossible to arrive at a positive conclusion. Most of the fossils as yet obtained, have a decided Cretaceous aspect, a species of Mactra found here being so closely allied to a species occurring in No. 1 near the mouth of Big Sioux, which we think we have proved to be of Cretaceous age, that we can find no well marked characters to distinguish them. A species of Baculite is also found in these beds, scarcely distinguishable from *B. ovatus* (Say.) This genus has hitherto been considered in the Old World as restricted to the Cretaceous epoch; while, on the other hand, the genus Hetangia which occurs in bed 3 of section, has never been found in the Old World in formations newer than the Lias. With evidence so conflicting before us, it would be premature to give any decided opinion, and we can only wait for the results of a second exploration of this interesting region. As we have already said in a former paper,* "We are inclined to think they hold a position near the base of the Cretaceous system, and are probably on a parallel with the Neocomien of the Old World, though they may be older." That well marked Jurassic beds occur at many places along the eastern base of the Rocky Mountains from the Saskatchewan to New Mexico, we have little doubt.

In regard to the age of the fresh water and estuary deposit, the evidence is even more

* Proceedings of Academy of Natural Sciences, Pa., Memoir by F. B. Meek and F. V. Hayden, 1857, 125.

conflicting. Mr. Meek and the writer have expressed in several papers an opinion based upon an inference drawn by Dr. Leidy from an examination of the vertebrate remains, that it might be contemporaneous with the Wealden of England. In a recent letter Dr. Leidy has very kindly given me the evidence upon which he based his inferences, with the permission to use it in this paper.

1st.—"*Trachodon* and *Deinodon*, two remarkable genera, are most closely allied with *Iguanodon* and *Megalosaurus* of the Wealden."

2d.—"In both formations remains of *Lepidotus* are found."

3d.—"Remains of *Crocodiles* and *Turtles* are discovered in both."

4th.—"The remaining two genera from the Judith, *Palæoscincus*, an herbivorous lacertian, and *Troodon*, another lacertian, are peculiar, and would not be unfit companions for the denizens of the Wealden world."

Again, the Molluscous fossils, though of a somewhat similar character, terrestrial, fluviatile and estuary, in most instances referrible to the same genera, do not seem to belong to types very closely allied to those characterizing the Wealden of England. On the contrary, they appear more related to tertiary types, and two species are very nearly identical with species common in the Lignite basin which we regard beyond a doubt as of the age of the Miocene Tertiary. *Paludina vetula* of the Judith deposit is so like *P. multilineata* of the Lignite basin, that it is with much hesitation we have regarded them as distinct, the only difference observable is that the volutions of *P. vetula* are a little more compressed and the umbilicus a little more open. *Paludina Conradi* of the Judith deposit is so closely related to *P. peculiaris* of the Lignite basin that almost no well marked differences can be pointed out. Indeed, had they been found associated in the same strata, we should have considered them identical. Fragments of a Trionyx occurring in bed E. of section, are undistinguishable from similar fragments found in the Lignite strata, near Square Buttes, below Fort Clarke. On the other hand, the only strictly marine fossil is scarcely distinguishable from *Ostrea subtrigonalis* from the upper cretaceous beds on Moreau and Grand Rivers.

Again, in no portion of the Upper Missouri have we met with any disturbance of strata belonging to well known Tertiary beds. The Tertiary beds of the White River deposit are found in the region of the Black Hills and Laramie Mountains, resting unconformably upon all rocks, from granite to Upper Cretaceous, and in no instance have the strata been disturbed. As far as my observations have extended, the same remark may be made of the Great Lignite Basin. We have, therefore, arrived at the conclusion, that the last great convulsion that uplifted the fossiliferous rocks on the Missouri, occurred after the Cretaceous epoch and prior to the deposition of the Tertiary. The fresh water and estuary beds at the mouth of the Judith, as has already been mentioned, are tilted at every angle, from

a horizontal to a vertical position. It is also evident that the convulsion was synchronous with that which uplifted the surrounding Cretaceous strata of No. 1, and that the mountains in the vicinity were raised up by the same forces that elevated the Black Hills, Laramie Mountains, &c. These facts strengthen the opinion that the deposits of the Judith basin, if not an American representation of the Wealden of Europe, are, at least in part, as old as Cretaceous.

Table Showing the Stratigraphical Position of the Fossils from the Bad Lands of the Judith.

VERTEBRATA.

		A	B	C	D	E	F	G
Palæoscincus costatus,	Leidy.					*		
Trachodon mirabilis,	"				*	*		
Troodon formosus,	"					*		
Deinodon horridus,	"				*	*		
Crocodilus humilis,	"				*	*		
Trionyx foveatus,	"					*		
Lepidotus occidentalis,	"						*	
Lepidotus Hayden,	"						*	

MOLLUSCA.

		A	B	C	D	E	F	G
Cyrena occidentalis,	Meek and Hayden.	*						
Corbula subtrigonalis,	"	*						
Corbula perundata,	"	*						
Physa subelongata,	"						*	
Paludina vetula,	"	*						
Paludina Conradi,	"	*						
Melania subtortuosa,	"							
Melania omitta,	"			*				*
Melania sublævis,	"							*
Melania invenusta,	"	*						
Vitrina obliqua,	"					*	*	
Helix occidentalis,	"						*	
Helix vitrinoides,	"						*	
Planorbis tenuivolvis,	"							
Planorbis amplexus,	"			*				
Unio Danai,	"							*
Unio Deweyanus,	"							*
Unio subspatulatus,	"							*

The remains described by Dr. Leidy in this Memoir from the Great Lignite Basin, were obtained from the lower beds, which partake somewhat of an estuary nature. In order that the lithological characters of this deposit may be understood and comparisons made with the other deposits of a somewhat similar character, I have added a section of the strata, mostly constructed from a local section taken about ten miles above Fort Clarke on the Missouri River. A few localities showing the geographical distribution of the beds which occur at this point, are also given, but it is impossible with the materials in our pos-

session at the present time, to construct a complete general section. The immense area occupied by this basin is shown on a geological map* published in the Proceedings of the Academy of Natural Sciences, June, 1858. Even yet it has not been fully explored, only the south-eastern and north-western boundaries being known by actual observation. I have traced its south-eastern outlines as they overlap the Cretaceous strata from the Missouri to the Black Hills, up the Yellow Stone River as far as the mouth of the Big Horn, but its northern and western limits are as yet unknown. In a former paper I estimated the area occupied by this basin at about 60,000 square miles, and at the same time expressed the opinion that when more fully examined, this estimate would be found too low, and I am now satisfied that it will be found to cover a much larger surface. It is a very interesting feature in the geology of Nebraska, that within the limits of the same territory there should be found such remarkable deposits with some characters in common, but so far as we know, entirely independent of each other. These basins may be characterized briefly as follows:

1st.—Bad Lands of the Judith; fresh water and estuary deposit; strata composed of friable or indurated sands, clays, and very impure earthy lignite; contains estuary, fresh water and land shells, with much silicified wood and a few leaves of dicotyledonous trees; chiefly remarkable for its peculiar saurian fauna. It is the upper portion of this deposit that seems to possess the estuary character.

2d.—Great Lignite Basin; also composed of loose sands and indurated layers, with many arenaceous and argillaceous concretions disseminated throughout the deposit; is chiefly remarkable for the beauty and extent of its fossil flora, only the lowest beds exhibiting an estuary character, gradually passing up into purely fresh water strata. It contains many beds of lignite, more or less pure, varying from one inch to seven feet in thickness, and in the vicinity of the lignite are found great quantities of silicified wood.

3d.—Tertiary Basin of White River; light and flesh-coloured indurated clays and grits, with many calcareous and argillaceous concretions; remarkable for its Mammalian and Chelonian fauna. This deposit is purely fresh water or lacustrine, and the few species of Mollusca which have been obtained from it, belong to the same genera and the same types as those living in the tributaries of the Missouri at the present time. The only indications of vegetable remains are a few fragments of silicified wood.

The Molluscous fossils of the Lignite Basin, though in many instances belonging to the same genera with those occurring in the White River deposit, are of quite different types. "It is an interesting fact, that the most nearly allied living representations of many of

* Explanations of a Second Edition of a Geological Map of Nebraska and Kansas. Proceedings Academy Natural Sciences of Philadelphia, June, 1858.

these species are now found inhabiting the streams of Southern Africa, Asia, China and Siam; apparently indicating the existence of a tropical climate in these latitudes at as late a period as the tertiary epoch."* The flora is also of quite a modern type, many of the leaves very strongly resembling those of our existing forest trees, and seem to belong to the genera *Platanus, Acer, Ulmus, Alnus, Populus, Betula, Smilax, &c.*, and to be of a subtropical character. The following section of the strata, as revealed by the channel of the Missouri at Red Spring, near Fort Clarke, will show quite clearly the lithological characters of the beds of the Lignite Basin, and comparisons can be made with sections of the other two deposits.

* Remarks, &c., by F. B. Meek and F. V. Hayden. Proceedings of Academy of Natural Sciences, Philadelphia, June, 1856.

Vertical Section, Exhibiting a Portion of the Strata of the Great Lignite Basin, near Fort Clarke, on Missouri.

A	30 feet.	Ferruginous sandy marl, passing downwards into variegated argillaceous grits; contains *Paludina Leai, P. retusa, P. Leidyi, P. trochiformis.*	Fort Union, Yellow Stone, Red Spring, ten miles above Fort Clarke.
B	2 inchs'.	Seam of impure reddish lignite.	Red Spring to Fort Union.
C	10 to 12 feet.	Yellowish gray, friable grit, with numerous argillaceous concretions in horizontal layers, containing beautiful impressions of leaves of the genera, *Platanus, Acer, Ulmus,* and *Ferns.*	Best developed and most fossiliferous at Red Spring, ten miles above Fort Clarke. It occurs also along the Missouri to Fort Union, where it contains fine impressions of Ferns as well as Dicotyledonous leaves.
D	3 inchs'.	Seam of lignite, very much mixed with clay and sand.	Red Spring and up the Missouri.
E	10 feet.	Yellowish gray grit, very friable, and containing layers of argillo-calcareous concretions, charged with leaves of the same species of plants, as in bed C.	Red Spring, &c.
F	3 inchs'.	Seam of earthy lignite.	Red Spring, &c.
G	15 feet.	Yellow and drab clay and friable sandstone, containing argillaceous concretions, with impressions of leaves like those in beds C. and E.	Red Spring to Fort Union.
H	4 inchs'.	Dark reddish, earthy lignite.	Red Spring, &c.
I	20 feet.	Yellow arenaceous grit, very friable, with some small *Paludinas, Corbulas, &c.*	Red Spring.
J	15 feet.	Alternations of lignite and clay. This bed is variable in thickness as well as in the proportions of the materials at different localities; contains large quantities of fresh water shells.	Fort Clarke, Red Spring, and other localities along the Missouri.
K	40 feet.	Heavy bedded gray and ferruginous friable sandstone, with great numbers of fossils, forming seams of shell marl; *Melania Nebrascensis, Paludina multilineata, P. peculiaris, Bulimus limneaformis, Corbula mactriformis,* with numerous impressions of Dicotyledonous leaves in argillo-calcareous concretions.	Very largely developed at Fort Clarke, Red Spring; is also seen where the Tertiary beds are exposed along Missouri and Yellow Stone.
L	2 feet.	Seam of impure lignite, probably local.	Red Spring; not seen at many localities.
M	4 feet.	Gray argillaceous friable grit, usually passing downwards into a dark brown carbonaceous clay.	Fort Clarke, Red Spring, and along Missouri.
N	2 feet.	Lignite, purest in the section.	Fort Clarke to Fort Berthold, to Fort Union.
O	6 feet.	Very dark carbonaceous clay passing down into very bluish gray arenaceous clay, contains at Fort Berthold a species of *Paludina,* also *Planorbis fragilis,* and a few impressions of leaves, petrified wood, &c.	Fort Clarke, Red Spring, Fort Berthold and Fort Union. It is also seen above Fort Union along the Missouri.
P	2 feet.	Rather pure lignite. This bed is local.	About 70 miles below Fort Clarke, near the point where the Tertiary beds first appear in ascending the Mo.
Q	40 to 60 feet.	Gray compact or somewhat friable concretionary sandstone; contains *Cyrena Moreauensis, C. intermedia, Thespesius occidentalis, Compsemys victus, &c.*	Near Long Lake on the Missouri. On Moreau River and Cherry Creek.

VERTEBRATA.

Thespesius occidentalis,	Leidy.	Proc. Acad.	Nat. Sci.,	Pa , VIII.	p. 311.
Ischyrotherium antiquum,	"	"	"	"	89.
Compsemys victus,	"	"	"	"	312.
Emys obscurus,	"	"	"	"	312.

MOLLUSCA.

Cyclas formosa,	Meek and Hayden.	Proc. Acad.	Nat. Sci.,	Pa., VIII..	p. 115.
Cyclas fragilis,	"	"	"	"	
Cyclas subellipticus,	"	"	"	"	
Cyrena moreauensis,	"	"	"	"	
Cyrena intermedia,	"	"	"	"	116.
Corbula mactriformis,	"	"	"	"	117.
Unio priscus,	"	"	"	"	
Bulimus teres,	"	"	"	"	
Bulimus vermiculus,	"	"	"	"	118.
Bulimus limneaformis,	"	"	"	"	
Bulimus nebrascensis,	"	"	"	"	
Pupa helicoides,	"	"	"	"	
Limnea tenuicosta,	"	"	"	"	119.
Physa longiuscula,	"	"	"	"	
Physa nebrascensis,	"	"	"	"	
Planorbis subumbilicatus,	"	"	"	"	120.
Planorbis convolutus,	"	"	"	"	
Planorbis fragilis,	"	"	"	"	
Velletia (Ancylus) minuta,	"	"	"	"	120.
Paludina multilineata,	"	"	"	"	
Paludina Leai,	"	"	"	"	121.
Paludina retusa,	"	"	"	"	122.
Paludina peculiaris,	"	"	"	"	
Paludina trochiformis,	"	"	"	"	
Paludina Leidyi,	"	"	"	"	123.
Valvata parvula,	"	"	"	"	
Melania minutula,	"	"	"	"	
Melania Anthonyi,	"	"	"	"	124.
Melania multistriata,	"	"	"	"	
Melania nebrascensis,	"	"	"	"	
Melania Warrenana,	"	"	"	1857,	137.

Melania tenuicarinata, Meek and Hayden. Proc. Acad. Nat. Sci., Pa., 1857, 137.
Cerithium nebrascensis, " " " " " viii. p. 125.

Explanation of the Geological Map.

I am indebted to the kindness of Lieutenant G. K. Warren, U. S. Topographical Engineers, for the beautiful Geographical Map which accompanies this paper.

A large portion of the map has been coloured inferentially, and therefore can hardly be accurate in detail. The formations along the Missouri River to Fort Benton are laid down correctly from the result of my own observations. It will be seen that I have represented no rocks of any age between Igneous and Cretaceous. The reason of this is, that we have no positive evidence of the existence of any intermediate deposits in that region. The discoveries in the Black Hills have rendered it more than probable that not only Jurassic, but Carboniferous Silurian, and perhaps rocks of other epochs are exposed by upheaval around the mountain elevations. If they are revealed they occupy but a small area, in the form of a narrow belt engirdling the metamorphic rocks which constitute the nucleus of elevation. I know, from personal observation, that the broad prairie country, very near to the foot of the mountains, is underlaid, for the most part, with Formations 1 and 4 of the Cretaceous Period; and it is quite probable that future explorations will not make any important changes in the map, excepting in the immediate vicinity of the mountains. The Cretaceous Formations 1 and 4 are represented by one colour, from the fact that we have comparatively little knowledge of their boundaries in that region.

Note.—Through the kindness of my friends, Prof. Baird and Mr. Drexler, I am permitted to refer to an exceedingly interesting group of fossils, recently obtained by the latter in the neighbourhood of Fort Bridger, and presented to the Smithsonian Institution. In a hasty examination of this collection some weeks since by my associate, Mr. Meek and myself, we at once recognised *Halysites catenulata*, (*Catenipora escharoides.*) In a subsequent examination recently, I think I was able to detect three other species of corals, referrible to the genera *Favosites*, *Syringopora*, and *Streptelasma*, an association of fossils which at once points to the existence of Silurian rocks in this far western locality. The fossils are completely silicified, and the matrix is a compact siliceous limestone, corresponding very closely in its mineralogical characters to the description given by Prof. Hall of the Niagara limestone in New York and Iowa. The locality where these fossils were obtained, is about twenty miles east of the South Pass.

A still more interesting group of fossils, with reference to this paper, forms a portion of the collection of Mr. Drexler, discovered near Fort Bridger. The material is composed

of an aggregation of casts of *Melanias* and large bivalves like *Unios*, held together by a slightly coherent, fine, gray calcareous clay, and indicates a fresh water deposit in that region very similar to that of the Bad Lands of the Judith. Mr. Drexler informs me, that the strata were uplifted and tilted in every direction like the beds of the Judith deposit, and the evidence indicates to my mind a fresh water formation of Lower Cretaceous or Upper Jurassic Age. We can thus see, that we have, as yet, but caught a glimpse of the interesting discoveries which await the geological explorer in the Far West.

ARTICLE XIII.

EXTINCT VERTEBRATA FROM THE JUDITH RIVER AND GREAT LIGNITE FORMATIONS OF NEBRASKA.

BY JOSEPH LEIDY, M. D.

THE present communication consists of descriptions, apparently of twelve new extinct species of fishes, saurians, chelonians, and mammals, from the territory of Nebraska. All of the fossil remains upon which these species are founded, with the exception of a single specimen, were discovered by Dr. F. V. Hayden, the zealous geologist and naturalist. The single specimen referred to, was obtained by Captain Alfred Sully, U. S. A., and was by him presented to the Academy of Natural Sciences of this city.

Of the fossils collected by Dr. Hayden, those referred to, *Trachodon*, *Deinodon*, *Palæoscincus*, *Troodon*, *Crocodilus*, *Lepidotus*, and part of those of *Trionyx* were obtained from the vicinity of the Judith River, one of the tributaries near the source of the Missouri River. The other specimens were obtained from the Great Lignite Formation, considered to be of Miocene Tertiary age by Messrs. Meek and Hayden, and were collected by the latter gentleman, during an expedition to Nebraska, under the command of Lieutenant G. K. Warren, Top. Eng. U. S. A., by whose permission the author has examined and described them.

The association of the remains of *Trachodon*, *Deinodon*, *Crocodilus* and *Lepidotus*, corresponding with the association of the remains of the closely allied *Iguanodon*, *Megalosaurus*, *Crocodilus*, and *Lepidotus* of the Wealden Formation of England, led the author to suspect the Judith River Formation was of cotemporary age, though he was fully aware of the

fact, that totally dissimilar animals have occupied different portions of the earth at the same period. The recent discovery of remains of the *Hadrosaurus*, another animal allied to the *Iguanodon*, in the Green Sand Formation of New Jersey, now inclines us to suspect that the Judith River Formation forms part of the great Cretaceous series of Nebraska, though we should not feel surprised if future explorations should determine it to be of Tertiary age.

1. *Extinct Vertebrata from the Judith River Formation.*

SAURIA.

Trachodon mirabilis.

With comparatively few exceptions, the living reptiles, whether turtle, saurian, serpent, or batrachian, are carnivorous in habit, and so far as we have been able to learn, such also appears generally to have been the case with the extinct forms of the same class, if we may judge from the anatomical structure of their remains.

In all the living forms of reptile life, when they are in possession of teeth, these organs are observed to be constructed for the penetration and cutting of food, whatever the nature of the latter may be; and in no known instance are they adapted to the crushing or mastication of substances. Even in the family of Iguanians, in which we find genera, such as the *Iguana** of South America and the *Amblyrhynchus* of the Galapagos Islands, using exclusively vegetable food, the teeth with their trenchant, jagged crowns, together form an instrument adapted to cutting like a saw, rather than one intended to bruise substances.

In the same category indicated in the preceding paragraph, it had been ascertained that all extinct reptiles belonged, until the discovery in the Wealden Deposit of England, by Dr. Mantell, of the great *Iguanodon*. It was therefore not at all surprising when the illustrious Cuvier first observed a tooth of the latter, that he pronounced it to be the incisor of a *Rhinoceros*, more especially as the specimen, which was in a much worn condition, really bore a strong resemblance to the corresponding tooth it was supposed to be. Nor did the determination at the time excite any degree of wonder, though it was a matter of much surprise that remains of the *Rhinoceros* should have been found in a formation so ancient as the Wealden.

Dr. Mantell afterwards, having sent a number of teeth of the *Iguanodon* for the examination of Cuvier; the latter was led to remark,—"It is perhaps not impossible that they may belong to a saurian, but to one more extraordinary than any of which we pos-

* In an *Iguana tuberculata* from St. Thomas, W. I., I found the stomach distended with vegetable matters alone, consisting of entire seeds, berries, fragments of soft stems, leaves and flowers.

sess knowledge. The character which renders them unique, is the wearing away of the crown transversely, as in the herbivorous quadrupeds."

Subsequent researches of Dr. Mantell led to the conclusion that the *Iguanodon* was a huge herbivorous saurian, which masticated its food in the manner of the existing pachyderm mammals.

Among the most interesting palæontological discoveries of Dr. Hayden in Western America, are several fossil specimens from the Judith River, which prove the former existence of a large herbivorous lizard, nearly allied to the great extinct *Iguanodon* of Europe.

The specimens, consisting of the unworn crown of a tooth, and portions of several much-worn teeth, at the time they were sent to the author for examination, were noticed in the Proceedings of the Academy of Natural Sciences of this city, as characteristic of a new genus of extinct herbivorous saurians, with the name of TRACHODON MIRABILIS. Subsequently a large collection of remarkably well preserved remains of another huge saurian, closely allied to *Trachodon* and *Iguanodon*, were obtained by our fellow member, W. Parker Foulke, Esq., from the green sand clay, in the neighbourhood of Haddonfield, New Jersey, not far distant from this city. The collection was presented by Mr. Foulke to the Academy of Natural Sciences, and was the subject of a short communication, in which the animal was characterized with the name of *Hadrosaurus Foulkii.*

Of the specimens of teeth referred to *Trachodon*, the unworn crown is the most important. It is represented in plate 9, figures 1—3, and is conical in form and slightly curved in its length. An examination of more perfect teeth of *Hadrosaurus* has led me to consider the specimen as having belonged to the lower jaw. Its inner face, (fig. 1,) is alone invested with enamel, is lozenge-shaped in outline, and is divided by a prominent median carina or ridge. The surfaces between the latter and the lateral borders of the crown are slightly depressed, smooth and shining.

The upper borders of the lozenge-like enamelled surface are the longer, but are neither serrated nor tuberculated, though they are slightly rugose towards the outer aspect of the tooth. The apex of the latter as formed by the enamelled surface is rounded, the lateral angles are obtuse, and the inferior angle is notched.

The portion of the tooth exterior to the enamelled surface is subtrihedral above and becomes pentahedral below, (figs. 2, 3,). The lateral or innermost divisions of the pentahedral portion of the crown, apparently exhibit the impress of the summits of laterally succeeding teeth, (fig. 2, *a*,) and the remaining surfaces of the exterior of the tooth are roughened with granular tubercles.

The broken base of the specimen is irregularly hexahedral in outline, and presents at its middle the open pulp cavity in the form of an ellipsoidal figure, with the long diameter

directed from without inwardly. The walls of the cavity are from one to one and a half lines thick, and appear quite roughened on their interior surface.

A transverse section of the crown, about the middle, gives an outline such as is exhibited in figure 4, a section of the bottom of the crown, as in figure 5, and a section of the broken extremity of the specimen, as in figure 6.

The measurements of this specimen are as follows:—Length of the enamelled surface, 13 lines; greatest breadth at the lateral angles of this surface, 5½ lines; diameter at base of crown, from within outwardly, 5 lines; diameter, laterally or antero-posteriorly, 4 lines.

Three much worn specimens of teeth of *Trachodon*, (figs. 7—15,) are apparently the remains of fangs; the crowns or portions of the teeth faced with enamel having been worn away. The specimens have the form of transverse fragments of a parallelogram, with concave sides, and with one border bevelled off. The triturating surface (figs. 9, 12, 15,) is concave, and presents a slightly elevated crucial ridge, with smaller diverging branches. The ridge is of a harder substance than the including dentine, and was no doubt intended to preserve a rough condition of the triturating surface as this is worn away. The under part of the specimens, (fig. 8 *e*,) is more or less hollowed, apparently from the pressure of succeeding teeth.

The length of the specimens is from 3 to 4 lines; the breadth of the triturating surface, from the parallel sides, from 2½ to 3 lines.

Two additional specimens, (figs. 16—20,) found with the preceding, may perhaps belong to a different animal, but it is quite probable also that they belong to a different part of the jaws of the same animal.

One of these specimens, (figs. 18—20,) consists of the crown of a tooth with a small portion of one side broken away. The crown is a broad four-sided pyramid, with an acute summit rising to a short point. The outer surface, as it is presumed to be, is nearly vertical, devoid of enamel, and elevated into a longitudinal ridge on one side, as represented in figure 20. This surface has been slightly roughened, but is worn smooth for part of its extent from attrition of an opposing tooth. The inner surface, (fig. 18,) is concave, and elevated into a longitudinal ridge, opposite that on the outer surface; besides which, it has three short ridges extending from the summit of the tooth. On the unbroken side of the specimen, it is likewise embraced by a ridge, curving from the summit to the base of the crown. The unbroken side of the latter, (fig. 19,) is triangular, convex, and tuberculated; is separated from the inner surface of the tooth by the curving ridge just mentioned; and from the outer surface by a ridge, which is transversely notched in the manner of the lateral borders of the teeth of *Iguanodon*. Below this side of the crown, the base of the specimen presents a sort of osseous envelope or thickening, which becomes obsolete on the outer face of the specimen. The base of the crown beneath and on each side is hollowed, apparently from the pressure of three successors.

The length of this specimen, on the outer side, as represented in figure 20, is 5½ lines; the breadth, 4 lines; the width at base, 4¾ lines.

Another specimen consists of the longitudinal fragment of a tooth, as represented in figure 16. The triturating surface, (figure 17,) is level and smooth, and corresponds with the transverse section of the fragment. This section is quadrate, with one of the sides formed by the broken border of the tooth. The other sides are concave, with the intervening angles prolonged; one of them being bevelled, and the other doubly so. The base of the fragment is enveloped in a thick, rugged osseous layer.

Explanation of Figures, Plate 9.

Figures 1—20, Teeth of TRACHODON MIRABILIS.

Figures 1—6, of the size of Nature.

Figures 7—20, magnified two diameters.

Figure 1. Inner view of an inferior tooth, exhibiting the lozenge-shaped enamel surface divided by a median carina. The form of the fang restored in outline.

Figure 2. Lateral view of the same specimen, exhibiting the roughened outer surface, and at *a* a portion of the surface impressed by the crown of a lateral successor.

Figure 3. Outer view of the same specimen.

Figure 4. Section of the crown at the position marked *b*, fig. 1.

Figure 5. Section at the position marked *c*, fig. 1.

Figure 6. Section at the broken extremity *d*, fig. 3.

Figure 7. Remains of a much worn tooth, apparently from the upper jaw, external view.

Figure 8. Internal view of the same specimen, exhibiting at *e* the hollowed base.

Figure 9. Triturating surface of the same specimen, exhibiting the crucial ridge of harder dentinal substance.

Figures 10, 11, 12. Similar views to those last indicated, of another tooth.

Figures 13, 14, 15. Similar views of a third tooth.

Figure 16. Outer view of the remainder of a much worn tooth; the base enveloped by a thick osseous crust.

Figure 17. Triturating surface of the same specimen.

Figure 18. A slightly worn tooth, of peculiar form; apparent inner view.

Figure 19. Lateral view of the same specimen.

Figure 20. Outer view.

DEINODON HORRIDUS.

In association with the remains of the huge herbivorous *Iguanodon*, Dr. Mantell found remains of a fit carnivorous cotemporary, the *Megalosaurus*. This great saurian, named by Dr. Buckland, and first discovered by him in the Oolitic Formation of England, possessed sabre-shaped teeth, with trenchant serrated edges, over three inches in length and an inch in breadth, supported in the jaws by an outer parapet wall, and passing one an other like the blades of scissors.

With the remains of *Trachodon*, Dr. Hayden likewise discovered those of a representative of the *Megalosaurus*, to which the name of *Deinodon* has been applied.

The specimens upon which the latter genus is based, consist of fragments of about a dozen teeth, of which three-fourths are nearly identical in form with those of *Megalosaurus*, while the others are more or less peculiar. The uniformity in shape of the teeth of *Megalosaurus* would appear to indicate that the three-fourths of the specimens alluded to, belonged to, at most, another species of the same genus, while the remaining specimens would typify a distinct genus. However, from the variety in form of the latter specimens, together with the fact that all the specimens present the same general appearance, as regards colour, texture, and constitution, I have been induced to regard them as belonging to a single animal, and feel that it must be left for further discovery to ascertain whether such a view is correct.

The teeth of *Deinodon*, resembling in form those of *Megalosaurus*, (figs. 21—34,) are laterally compressed conical, with a curvature backward, and with the anterior and posterior borders trenchant and crenated. In transverse section they are quadrately elliptical, with acute poles corresponding with the trenchant edges of the teeth. These specimens, as indicated in figures 25, 29, are generally worn off at the summits, the borders extending therefrom, and in several instances at the sides. The attrition of the teeth indicates those of the upper and lower jaws to have closed upon one another like the blades of scissors, so that they were well adapted for penetrating, tearing and cutting their animal food.

Of the remaining specimens of teeth, whose form is peculiar in comparison with that of the others, one is the crown of a conical tooth, with feeble lateral compression, and is represented in figures 46, 47. Its transverse section, (figure 48,) is quadrately rotund, with two acute angles, corresponding with crenated ridges, one of which occupies the inner side of the tooth, while the other is situated postero-externally. The summit of the specimen is worn off in a sloping manner anteriorly. The tooth probably occupied a position in the back of the jaw.

A second specimen, represented in figures 37—40, consists of the greater portion of the crown of a tooth whose transverse section forms the half of an ellipse. The anterior border is obtusely rounded; the sides are compressed, and the posterior border forms a plane, elevated at the middle and bounded by acute crenated margins. The apex of the tooth is worn off in a sloping manner posteriorly.

A third specimen, represented in figures 35, 36, consists of a small fragment of a large tooth, like that just described. The latter two specimens perhaps represent canine teeth.

The last of the aberrantly formed specimens, represented in figures 41—45, consists of the crown of a comparatively small tooth, possessing nearly the shape of the two teeth

just mentioned, but its posterior margins are not crenated, and the intervening back surface is more elevated. The apex of the specimen is worn off in a sloping manner anteriorly. This tooth I suspect to represent an incisor.

As the entire dentition of *Megalosaurus* has not yet been ascertained, it may turn out to be the case, that in other parts of the jaws than those known, it possesses teeth like the ones above described as peculiar. Should on future discovery such a condition of things be proved to exist, *Deinodon* would then cease to be any thing more than a second species of *Megalosaurus*.

As anatomical and geological evidence favour the view that *Iguanodon*, *Trachodon*, and *Hadrosaurus*, were amphibious, it is not unlikely that *Megalosaurus* and *Deinodon* infested the shores, upon which the former quietly grazed or browsed, and proved to them fierce and destructive enemies. The two carnivorous saurians perhaps held the same office in relation to the more bulky herbivorous lizards, that we find to exist between the larger existing feline animals, and the pachyderm solipedal and ruminant mammals.

Explanation of Figures, Plate 9.

Figures 21—48, Teeth of DEINODON HORRIDUS; all the size of Nature.

Figure 21, *f. g.* Two fragments of a large sabre-shaped tooth; lateral view.

Figures 22, 23. Transverse sections at the positions marked *f. g.*

Figure 24. Front view of the same fragments.

Figure 25. Summit of a sabre-shaped tooth.

Figure 26. Section at *h.*

Figure 27. Summit of another specimen.

Figure 28. Section at *i.*

Figure 29. Lateral view of the summit of a sabre-shaped tooth, exhibiting the enamel partially worn off.

Figure 30. Section of the tooth at *j.*

Figure 31. A similar tooth.

Figure 32. Section at *k.*

Figure 33. A small tooth of the same form.

Figure 34. Section at *l.*

Figure 35. Fragment of a large tooth, with its posterior border forming a plane surface as indicated in the section, Figure 36, taken at *m.*

Figure 37. Lateral view of the summit of a tooth like the preceding specimen.

Figure 38. Posterior view of the same specimen.

Figures 39, 40. Sections at *n. o.*

Figure 41. Posterior view of the crown of a tooth, perhaps an incisor.

Figure 42. Lateral view of the same.

Figures 43, 44, 45. Sections from the positions indicated.

Figure 46. Postero-internal view of a conical tooth.

Figure 47. Antero-external view of the same specimen.

Figure 48. Section at *p.*

Crocodilus humilis.

With the remains of Trachodon and Deinodon, Dr. Hayden discovered half a dozen teeth, apparently of a small species of Crocodile, though they may probably belong to an acrodont lacertian reptile.

Five of the teeth, (figures 9—17, plate 11,) are conical and moderately curved; and on their inner part, in front and behind, they present the usual pair of acute ridges. About the middle of the crown, their enamelled surface is slightly folded, especially on the inner side of the teeth. They are solid, except that a small conical cavity occupies the centre of their base. The latter is slightly concave and eroded in appearance; the borders only being broken, indicating that the teeth were about to be shed or actually were so, although most of them appear unworn.

One of the specimens of teeth, (figures 18, 19,) is mammilliform, slightly compressed, and finely rugous in the length of the crown. It is likewise solid, and has the base presenting the same appearance as the other specimens.

Explanation of Figures, Plate 11.

Figures 9—19. Teeth of Crocodilus humilis, of the size of Nature.
Figures 9, 10. Inner and lateral views of a conical tooth.
Figure 11. Section of the same at base.
Figures 12, 13. Inner and lateral views of another conical tooth.
Figure 14. Section at base.
Figures 15, 16, 17. Inner, lateral, and sectional views of a third tooth.
Figures 18, 19. Outer and lateral views of a mammilliform tooth.

Palæoscincus costatus.

In association with the remains of the great extinct saurians, *Trachodon* and *Deinodon*, Dr. Hayden discovered the tooth of a true and gigantic representative of the family of Iguanians. The tooth is constructed on the same general plan as those of the existing Iguanas, consisting of a sub-palmate crown, with a compressed cylindrical fang.

The crown of the fossil tooth, (figs. 49—52, plate 9,) is compressed pyramidal with the apex truncated, and is broader than long. Its base is elevated into a ridge; and from the sides, ridges extend to the free borders of the crown, where they end in points, some of which are acute and others are blunt. From the basal ridge of the crown, the tooth gradually narrows into a compressed cylindrical, hollow fang, the lower part of which, in the specimen, is broken away.

The breadth of the crown of the fossil tooth is 4 lines; its length from the basal ridge is 2½ lines; and its thickness in the position of the latter, is 1½ lines. The breadth of the fang at its broken end, is 2 lines; its width, 1¼ lines.

In structure, the tooth appears wholly composed of dentinal substance, and exhibits no trace of enamel upon the crown.

A proportionate increase in length of *Palæoscincus* with the size of the teeth, in comparison with those of *Iguana tuberculata*, would give the animal a length of over thirty feet, which is however not probable, as we observe no necessary relation of length of animals in proportion with the size of their teeth.

In the same formation from which the tooth of *Palæoscincus* was obtained, there were found about a dozen vertebral bodies, which may belong to the same animal, and if this is the case, we may obtain from them a more just idea of the size of the latter. These vertebral bodies are cylindroid, comparatively slightly constricted, and have the extremities slightly concave. In the true Iguanas the vertebral bodies have a totally different form, as they interlock with one another by a ball and socket joint; this, however, is no positive evidence that the fossil specimens do not belong to *Palæoscincus*. Some of these vertebræ are represented in figures 56—61, and they measure from 7 to 9 lines in length.

Accompanying the vertebral bodies, there is an ulna, represented in figure 8, plate 11, which is solid, and perhaps belongs to the same animal.

Palæoscincus, probably like the marine *Amblyrhynchus* of the Galapagos Islands, was aquatic and fed upon plants.

Explanation of Figures, Plates 9, 11.

Figures 49—52. Tooth of PALÆOSCINCUS COSTATUS; magnified two diameters.
Figures 49, 50. Outer and inner views.
Figure 51. Apparently the forward view.
Figure 52. Section at the broken extremity of the specimen.
Figures 56—61. Vertebræ; of the size of Nature.
Figure 56. Anterior view of a dorsal vertebral body.
Figure 57. Lateral view.
Figure 58. Anterior view of an anterior caudal vertebra.
Figure 59. Lateral view.
Figure 60. Anterior view of a posterior caudal vertebra.
Figure 61. Lateral view.
Figure 8, plate 11. An ulna, natural size, suspected to belong to *Palæoscincus costatus*.

TROODON FORMOSUS.

In association with the remains previously described from the Judith River, Dr. Hayden discovered the tooth of a large Monitor, to which the above name has been applied. Probably aquatic like many of the living Monitors, the voracious *Troodon* was most likely a troublesome enemy to the peaceful plant-eating *Palæoscincus*.

The fossil tooth (figs. 53–55, plate 9,) bears much resemblance to one of the lateral denticles of the teeth of the great extinct shark, *Carcharodon angustidens*, and under other circumstances might readily have been mistaken for such.

The specimen is black and shining, and is laterally compressed, conical, and curved backwards, as observed in the *Monitor ornatus*. The margins of the tooth are trenchant, and strongly denticulated; the denticles possessing the same form as the crown itself. On the convex border of the tooth there are eleven denticles, and on the concave border, seven; and on both borders the points of the denticles diverge upwardly.

The broken base of the crown is elliptically trapezoidal, and is hollowed on the interior. The crown is invested with enamel, which on one side of its summit is worn off by the attrition of an opposing tooth passing it like the blades of a pair of scissors. The length of the specimen is 3 lines; its antero-posterior diameter at base, 2 lines; and its transverse diameter, 1½ lines.

I have no evidence that part of or all of the vertebræ supposed to belong to *Palæoscincus*, do not really appertain to *Troodon*. This question must be left for future investigation to determine.

Explanation of Figures, Plate 9.

Figures 53—55. Tooth of TROODON FORMOSUS; magnified three diameters.

Figure 53. Outer view.

Figure 54. Inner view, exhibiting the enamel worn from the summit.

Figure 55. Section at the base of the specimen.

CHELONIA.

TRIONYX FOVEATUS.

Among the fossils of Dr. Hayden's Judith River Collection, there are a number of small fragments of costal and sternal plates, having much resemblance to the corresponding parts of our living soft-shelled Turtles, forming the genus *Trionyx*.

The exterior surface of the fragments of costal plates, (figure 2, plate 11,) is impressed with shallow pits, except near the borders of the plates. The pits are smaller and rounded at the vertebral extremities of the latter, and become larger outwardly, assuming a polyhedral, often oblong and reniform outline. The fragments of the sternal plates, (figure 1, plate 11,) have their exterior surface covered with short vermicular ridges, which recall a remote appearance to Arabic letters. One of the fragments of a costal plate, apparently the third or fourth, represented in figure 2, is almost 11 lines wide, and 2 lines thick. Two fragments of a hyposternal plate, (figure 1,) are 3 lines in thickness.

In association with the remains of several other genera of Turtles, and of some other animals in the Great Lignite Tertiary Basin, near Long Lake, below Fort Clark, Nebraska, Dr. Hayden obtained small fragments of the carapace or osseous shell of a Turtle, not distinguishable from those referred to, *Trionyx foveatus.* The specimens are too imperfect positively to determine whether they actually belong to the same species. Fragments of a last costal plate, represented in figure 3, plate 11, measures 4 lines in thickness, and are closely foveated on the exterior surface, in the manner described in the account of the corresponding plates of *Trionyx foveatus* from the Judith River.

Explanation of Figures, Plate 11.

Figures 1—3. Fragments of the carapace and sternum of TRIONYX FOVEATUS, of the natural size.

Figure 1. Two fragments of a hyposternal plate; an ideal outline given in the restored condition.

Figure 2. Fragment of a left costal plate.

Figure 3. Fragment of the last right costal plate, supposed to belong to the same species as the preceding.

FISHES.

LEPIDOTUS OCCIDENTALIS.

The genus of ganoid fishes *Lepidotus*, appears to have come into existence during the Liassic period, to have extended through the Oolitic, Wealdean, and Cretaceous periods, and to have become extinct in the Eocene Tertiary period.

As if to keep up the association, in the manner that Dr. Mantell found together in the Wealdean deposits the remains of *Iguanodon*, *Megalosaurus*, *Crocodilus*, and *Lepidotus*, Dr. Hayden discovered with the remains of *Trachodon*, *Deinodon*, and *Crocodilus*, a half dozen ganoid fish scales, which appear to belong to the genus *Lepidotus.* The specimens may indicate two species, but with equal probability they may appertain to a single one.

Four of the scales, (as represented in figures 20, 21, plate 11,) are lozenge-shaped, with their root prolonged from one side in the direction of the longest diameter of the lozenge. Two of the scales, (as represented in figures 22, 23,) are square, with their root projecting from one of the longer sides. All the specimens are invested with thick, shining, enamelled substance; and one of the square scales exhibits on its free surface, parallel square lines of growth.

The largest lozenge-like scale has the sides of its free or enamel surface about 4 lines long; and the smallest has two of the sides 3 lines long, the other sides 2 lines long. The larger square scale has its long sides 5 lines, and its short sides 3½ lines.

Explanation of Figures, Plate 11.

Figures 20—23. Scales of LEPIDOTUS OCCIDENTALIS, of the natural size.

2. *Extinct Vertebrata from the Great Lignite Formation.*

MAMMALIA SIRENIA?

Ischyrotherium antiquum.

Among the most enigmatic fossil remains of vertebrata collected by Dr. Hayden, in Nebraska Territory, are a number of fragments of bones, obtained from an out-lyer of the Great Lignite Tertiary Formation, between the Moreau and Grand Rivers.

The specimens consist of two vertebral bodies, the half of a third one, two apparent transverse processes, and numerous fragments of ribs. We cannot positively determine the affinities of the animal represented by these bones, but from their solidity of structure and the cylindroid form of the ribs, we suspect *Ischyrotherium* to be more nearly allied to the Manatee than to any other known animal.

The vertebral bodies, (figs. 8—11, plate 10,) apparently posterior dorsal, are segments of a cylinder compressed from above downward, so that their articular faces are transversely oval in outline. They are comparatively slightly constricted at the middle; and in this position present a number of orifices of large vascular canals, which converge to the centre of the bodies. Both articular faces are slightly concave, with obtuse margins. The dorsal surface, (figure 8, plate 10,) exhibits a narrow tract corresponding with the spinal canal, and on each side, a broad, concave, porous articular surface for conjunction with the sides of the vertebral arch.

The broken vertebral body, (figure 11, plate 10,) presents an equally dense structure throughout, except at the articular surfaces, which are finely porous. The large vascular canals are seen in this specimen converging from the middle circumference to the centre of the bone, and smaller ones are observed pursuing a like course from the borders of the articular surfaces.

The specimens of transverse processes, (figs. 12, 13, 14, plate 10,) are remarkable for their robust character and cylindroid form. The outer extremity of the longer specimen, though abruptly truncated, appears nevertheless to be entire. The inner extremity of the specimens, inferiorly, presents a broad, convex, porous, articular surface, for conjunction with the corresponding surfaces of the vertebral bodies. Above this surface, there is a smooth arching one forming the side of the vertebral canal and overhung by the abutment for the articular and spinous processes.

The numerous fragments of ribs, generally indicate these bones to have a curved fusiform shape, as seen in fig. 15, plate 10, representing one of the more perfect specimens. In structure they exhibit the same remarkable solidity noticed in the corresponding bones of the Manatee.

Though I have supposed the remains above described to indicate the former existence of a mammal allied to the Manatee, they yet appear to me of such a singular character, that I have suspected they may have belonged to an aquatic reptile, unlike any known, and perhaps foreshadowing in its constitution the Sea Cows, just as Iguanodon appears to have foreshadowed the herbivorous pachyderms of the Eocene Tertiary Period.

Explanation of Figures, Plate 10.

Figures 8—15.—Vertebræ and rib of ISCHYROTHERIUM ANTIQUUM; two-thirds the diameter of nature.

Figure 8. Dorsal view of vertebral body. Articular surface on each side.

Figure 9. Anterior view of the same vertebral body.

Figure 10. Ventral view of a second and similar specimen.

Figure 11. Broken surface of a third specimen, exhibiting its dense structure and converging nutritious canals.

Figure 12. Inferior view of a vertebral half arch and transverse process, exhibiting the articular surface, adapted to a corresponding one of figure 8.

Figure 13. Anterior view of same specimen as the last.

Figure 14. Anterior view of another specimen like that indicated in figures 12, 13.

Figure 15. Fragment of a rib, with outline sections (16, 17,) of the size of nature, from the upper end and middle.

SAURIA.

THESPESIUS OCCIDENTALIS.

Several vertebræ, together with a first phalangial bone, from Nebraska, appear to indicate a deino-saurian as colossal as the *Iguanodon* of England, or the *Hadrosaurus* of New Jersey. Two of the specimens are exceedingly like mammalian lumbar vertebræ, especially those of the Elephant or Mastodon, and might readily be taken for such, were it not that they possess well marked processes for the articulation of chevron bones.

One of the vertebræ from near the trunk, and another, which I suspect to belong to the same animal, from near the end of the tail, together with the phalanx, were discovered by Dr. Hayden, in the Great Lignite Formation, at Grand River, Nebraska. Another large vertebra from near the trunk, was obtained by Captain Alfred Sully, U. S. A., from an Indian, and presented to the Academy of Natural Sciences of this city. This specimen Dr. Hayden supposes to have been derived from the same locality in which he discovered the others.

The bodies of the two large vertebræ, viewed in front, (fig. 2, plate 10,) are quadrately oval in outline, and notched above; the notch corresponding with the spinal canal. One of them measures about 5 inches transversely and vertically; the other, 4½ inches transversely and 4½ vertically; and their length is about 2¾ inches. They are narrowed concavely from their articular borders, (fig. 1,) and are bounded below (fig. 3) by articular processes, for chevron bones, an inch in diameter. Their anterior articular face, (figs. 1, 2,) is moderately convex; and their posterior face concave, with a depth of nearly

half an inch. Robust transverse processes broken off in the specimens, projected from the conjunction of the vertebral arch and body. The spinal canal, retained entire in the smaller specimen, is circular and one inch in diameter.

The smaller caudal vertebral body, (figs. 6, 7,) has its anterior surface nearly plain or slightly depressed, while its posterior surface is moderately concave. Its length is about equal to its height, which is 2 inches, while its breadth is 2¾ inches.

The first ungual phalanx, (figs. 4, 5,) resembles the corresponding bones of *Iguanodon* and *Hadrosaurus*. It is 5 inches long; 4½ wide at base, by 3½ thick; and 4 inches wide at the distal end, by 2½ thick. Deep concavities exist each side of the distal extremity for the attachment of lateral ligaments. The proximal articular surface is a transverse reniform concavity; the distal articulation a transverse convexity slightly depressed towards its middle.

Had the bones of *Thespesius* been found in association with the remains of *Trachodon* or *Deinodon*, or in the same geological formation, I would have suspected that they belonged to one of the latter.

Explanation of Figures, Plate 10.

Figures 1—7. Vertebræ and phalanx of THESPESIUS OCCIDENTALIS; one half the diameter of nature.

Figure 1. Lateral view of an anterior caudal vertebra.

Figure 2. Anterior view of same specimen as the last one.

Figure 3. Ventral view of same specimen, exhibiting the articular processes of the chevron bones.

Figure 4. Upper view of a first phalangial bone.

Figure 5. Lateral view of the same.

Figure 6. Lateral view of a posterior caudal vertebral body.

Figure 7. Posterior view of the same specimen.

CHELONIA.

COMPSEMYS VICTUS.

The above name is proposed for a species of turtle, indicated by several fragments of a carapace, obtained by Dr. Hayden, from the Great Lignite Tertiary Basin, near Long Lake, Nebraska. The more characteristic specimens consist of a vertebral plate, and the greater portions of the fifth and last right costal plates.

The vertebral plate, (fig. 5, plate 11,) is about an inch in its antero-posterior and transverse diameters. The fifth costal plate, (figs. 6, 7, plate 11,) is much arched, is an inch and a quarter wide, two lines thick, and when perfect, appears to have been about four inches long. The fragment of a last costal plate is three lines thick.

Marks upon the fifth costal plate, of the fourth and fifth vertebral scutes, indicate these to have been about two inches in width.

The peculiarity of the specimens which has led to the proposal of the genus, consists in

their exterior surface being closely studded with uniform granular tubercles, which give to them a shagreened appearance, quite different from any thing I have had the opportunity of seeing in other turtles.

Explanation of Figures, Plate 11.

Figures 5, 6, 7. Fragments of plates of the carapace of COMPSEMYS VICTUS, of the natural size. The carapace represented as partially but ideally restored, with the relative position of the fossil fragments.

Figure 5. A vertebral plate. Figure 6. A portion of a right costal plate.

Figure 7. Marginal view of the same specimen as the last, giving an idea of the curvature of the carapace.

EMYS OBSCURUS.

Associated with the remains of *Compsemys*, and fragments of the shell of another turtle previously mentioned as not being distinguishable from those of *Trionyx foveatus*, Dr. Hayden found fragments of a carapace, sufficiently characteristic only to determine that they indicate a species of *Emys*. The best of the fragments, represented in figure 4, plate 11, consists of the greater portion of a costal plate, which is sixteen lines wide, a line and a half thick, and in its perfect state may have been about five inches long.

Explanation of Figure, Plate 11.

Figure 4. Fragment of a right costal plate of EMYS OBSCURUS; restored in outline.

FISHES.

MYLOGNATHUS PRISCUS.

The very singular-looking fish, *Chimæra*, of the European seas, was represented during the Miocene period in Nebraska, by a genus for which the above name has been proposed. Its former existence is indicated by specimens of dental plates, like those of *Chimæra*, adapted to the crushing of mollusca and crustacea, used as food. The specimens, consisting of an upper maxillary and a premaxillary plate, were obtained by Dr. Hayden from the Great Lignite Basin near Long Lake, Nebraska.

The upper maxillary plate, (figs. 24, 25, 26, plate 11,) consists of a narrow triangular bone, containing two teeth. The specimen is broken at its two extremities, and when perfect appears to have been a little over an inch in length. Its posterior part is 3¾ lines wide, and about 4½ lines thick. The free convex surfaces of the peculiar porous teeth, occupy nearly the entire length and breadth of the bone, (fig. 25, plate 11,) and are separated from each other by an oblique, linear tract. The anterior tooth is lozenge-shaped in outline, and when perfect appears to have been about ½ an inch in length, and 1¾ lines

in breadth. The posterior tooth, somewhat ellipsoidal in outline, appears, when perfect, to have been about 8 lines long, and is three lines wide.

The premaxillary dental plate, (figs. 27—30, plate 11,) is irregularly lozenge-shaped in its vertical outline antero-posteriorly, is a little over an inch in its long diameter, 5 lines in its depth, and 3 lines in its greatest thickness. Its anterior border is convex, the inner and outer surfaces are vertical, slightly depressed planes, and the crushing surface is concave.

Explanation of Figures, Plate 11.

Figures 24—30. Upper maxillary plates of MYLOGNATHUS PRISCUS, of the natural size.

Figure 24. Inner view of the maxillary plate, exhibiting the surfaces of the two teeth projecting below.

Figure 25. Oral or inferior surface of the same.

Figure 26. Posterior extremity of the same, exhibiting the columnar structure of the teeth.

Figures 27, 28. Outer and inner view of a pre-maxillary plate.

Figures 29, 30. Triturating surface and upper view of the same.

In Commodum Lectoris, Synopsis Generum et Specierum Quæ in hoc Opere et Alibi Discribuntur.

MAMMALIA SIRENIA?

1. ISCHYROTHERIUM ANTIQUUM, Leidy; Proc. Acad. Nat. Sci., Phila., 1856, 89.

SAURIA.

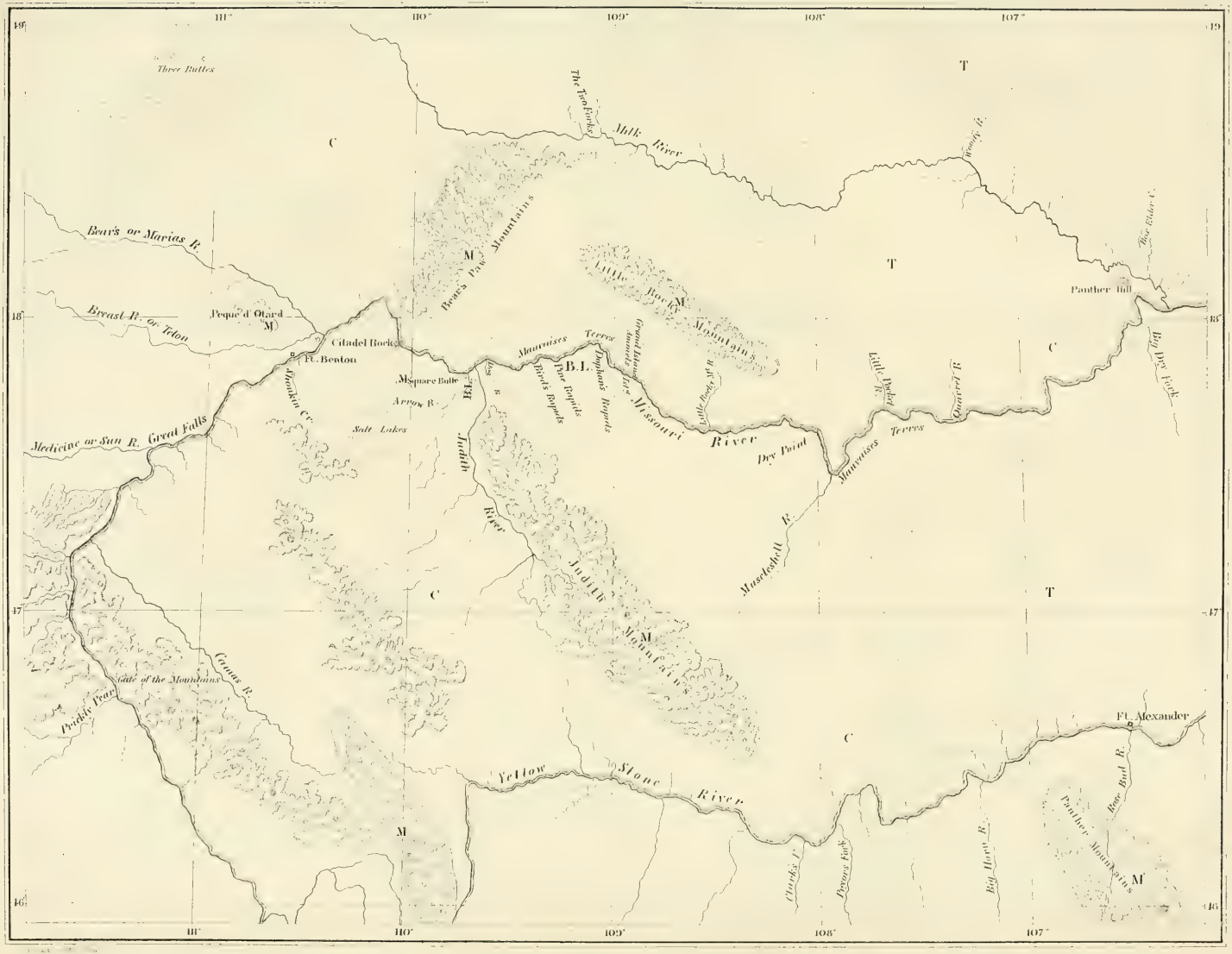
2. TRACHODON MIRABILIS, Leidy: Proc. Acad. Nat. Sci., Phila., 1856, 72.
3. DEINODON HORRIDUS, Leidy: Ibidem.
4. PALÆOSCINCUS COSTATUS, Leidy: Ibidem.
5. TROODON FORMOSUS, Leidy: Ibidem.
6. CROCODILUS HUMILIS, Leidy: Ibidem.
7. THESPESIUS OCCIDENTALIS, Leidy: Ibidem, 311.

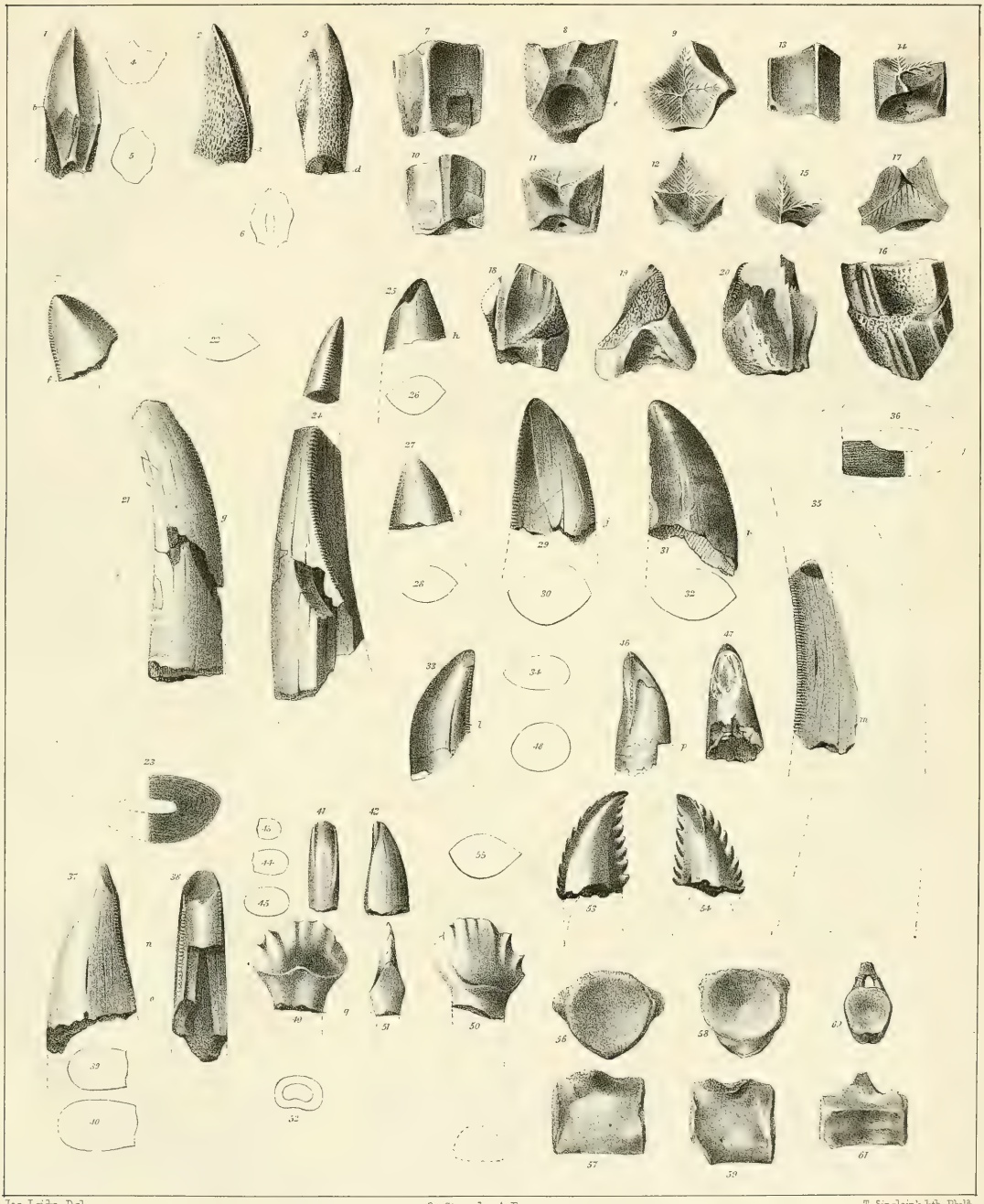
CHELONIA.

8. TRIONYX FOVEATUS, Leidy: Proc. Acad. Nat. Sci., Phila., 1856, 73, 312.
9. COMPSEMYS VICTUS, Leidy: Ibidem.
10. EMYS OBSCURUS, Leidy: Ibidem.

PISCES.

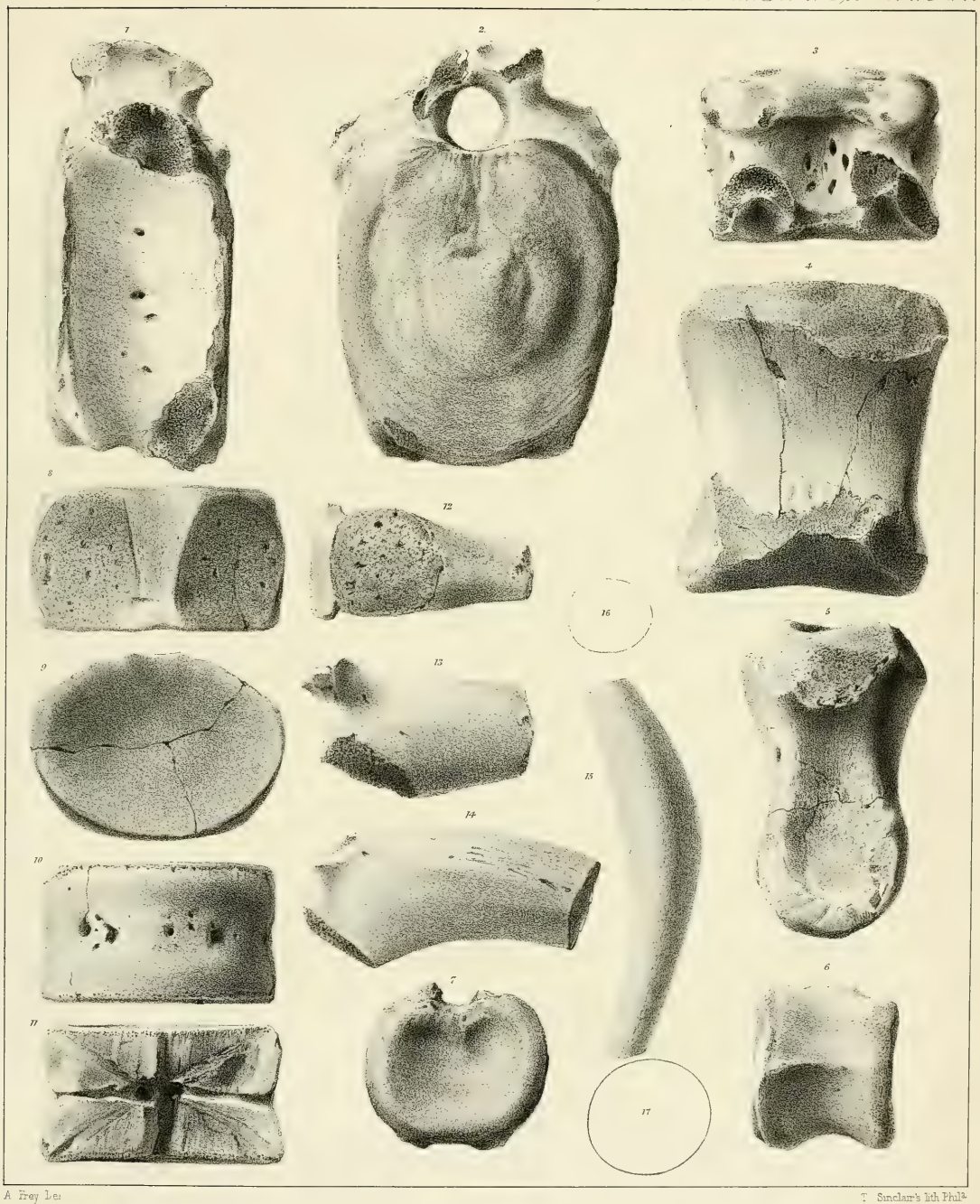
11. LEPIDOTUS OCCIDENTALIS, Leidy: Proc. Acad. Nat. Sci., Phila., 1856, 73. *Lepidotus Haydeni*, Leidy: Ibidem.
12. MYLOGNATHUS PRISCUS, Leidy: Ibidem, 312.


Three Buttes
The Two Forks
Milk River
Wooey R.
Bear's or Marias R.
Breast R. or Teton
Pequé d'Otard
Citadel Rock
Ft. Benton
Square Butte
Arrow R.
Salt Lakes
Medicine or Sun R.
Great Falls
Beaver's Paw Mountains
Little Rocky Mountains
Maurises
Terres
Bird's Rapids
Pine Rapids
Dauphin's Rapids
Grand Rapids
Rocky Rapids
Little Rocky R.
Missouri River
Dry Point
Little Porcupine R.
Charrier R.
Dry Fork
Panther Hill
Musdeheld R.
Judith River
Judith Mountains
Gates of the Mountains
Prickly Pear
Gates R.
Ft. Alexander
Yellow Stone River
Clarks F.
Pryors Fork
Big Horn R.
Panther Mountains
Bear Bud R.
T
C
M
B.L.
T Tertiary
C Cretaceous
M Metamorphic
B.L. Bad Lands of the Judith



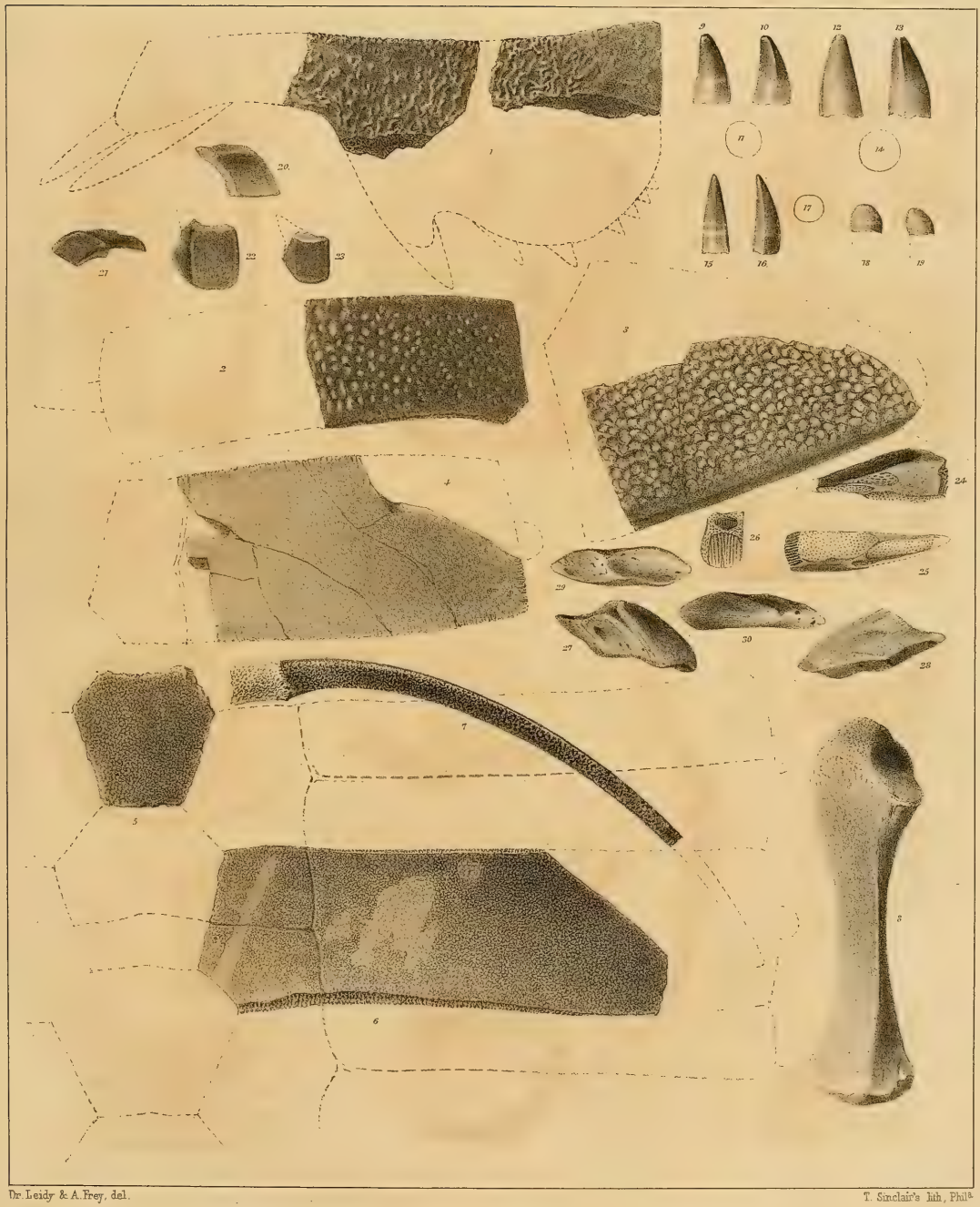
Jos. Leidy, Del. On Stone by A. Frey. T. Sinclair's lith, Phil.a

1–20. Trachodon mirabilis. 21–48 Deinodon horridus
49–52. Palaeoscincus costatus. 53–55. Troodon formosus



A. Frey Lith. T. Sinclair's lith. Phil.a

1–7. Thespesius occidentalis. 8–17. Ischyrotherium antiquum.



Dr. Leidy & A. Frey, del.

T. Sinclair's lith., Phila.

1–3. Trionyx foveatus 4. Emys obscurus 5–7. Compsemys victus
9–19 Crocodilus humilis. 20–23, Lepidotus occidentalis. 24–30 Mylognathus priscus.

ARTICLE XIV.

A SKETCH OF THE BOTANY OF THE BASIN OF THE GREAT SALT LAKE OF UTAH.

BY E. DURAND.

THIS sketch has been suggested by the examination of a collection of botanical specimens, made in the vicinity of the Great Salt Lake City, by Mrs. Jane Carrington, and placed in my hands through the kind remembrance of our colleague, Colonel Thomas L. Kane.

All the plants that have, thus far, been received from that extraordinary region, and have been recorded in the various botanical reports of Professor Torrey, were collected by Colonel Fremont, in 1843 and '45; by Major Stansbury, in 1849 and '50; and by Lieut. Beckwith, in 1854. These collections, together with that lately handed to me by Col. Kane, although affording but a limited number of species, are well deserving of a particular notice:—1st, As exhibiting two distinct sets of plants; some vegetating almost exclusively in a soil saturated with saline principles; others never growing inside of such soils. 2d, As evincing in the latter set of plants a complete identity with those of the surrounding parts of Oregon, contrary to the pre-conceived idea that the vegetation of the belt of the Great Salt Lake, (a lake, the waters of which contain 22 per cent. of saline matter,) would be stamped with a peculiar character, originating in the ambient action of an atmosphere supposed to be more or less charged with saline vapours, or with the pulverulent saline efflorescence, which, in dry weather, covers the whole surface of the low plains, and must be dispersed by the winds on the surrounding valleys. 3d, On account of the limited number of distinct species that have been afforded by the four collections above mentioned; a circumstance inducing the conjecture, that the vegetation of the Great Salt Lake Basin is, in reality, much less diversified than that of the other sections of Oregon.

The vegetable growth of the saline flats bordering the Lake, is limited to about one dozen species of hardy and mostly shrubby plants of a mournful glaucous foliage, little calculated to enliven the surrounding scenery. The most prominent of these plants are the *sarcobatus vermiculatus*, (the Pulpy Thorn of Lewis and Clarke,) the *Grayia polygonoides*, (Grease Wood,) and other species of the order *Chenopodiaceæ;* perhaps several species of *Artemisia*, (the sage of the Western travellers,) and the famous Bunch Grass, a large grass, yielding a good pasture, the botanical character of which has not yet, I think, been determined.

The vegetation of the valleys, of the mountain-tops, and of the small meadows at their base, do not differ in any particular from that of the surrounding regions lying out of the reach of the saline emanations of the Lake. In the lower and swampy grounds, are willows and rose bushes, horse-tails and grasses, interspersed with violets and anemones, some species of the order *Liliaceæ* and other meadow flowers; the valleys above sparkle with more brilliant blossoms of *Leguminosæ, Rosaceæ, Onagraceæ, Compositæ, Borraginaceæ, Polemomaciæ, &c.;* whilst, on the more elevated zones, are found clusters of various dwarfish and acerose species of *Phlox*, the purple *Eriogonum* and a few other mountain species growing under the shade or by the side of stunted trees of the coniferous tribe.

If, comparatively to other Oregon sections of equal extent, the Flora of the Great Salt Lake Basin should prove to be really as limited in the number of its species as it appears to be, judging from the examination of the four collections referred to, it is proper to inquire into the causes of this apparent scantiness of distinct species in the vegetation of that strange country.

First of all, the whole circumference of the Lake consists of extensive low plains which have evidently, at a remote period, formed part of it, and are so little elevated above the surface of the water, that a rise of a few feet above its present level, would inevitably flood their entire superficies to a great distance north and south. All these flats are composed of the same soil, a mixture of sand and clay, highly saturated with chloride of sodium, and affording no other vegetation but occasional patches of saline plants. In rainy weather, these plains are covered with a thick mire, almost impassible to the traveller, which dries rapidly under the rays of the sun, when it becomes covered with a light crystalline efflorescence, resembling white-frost; the reflection of which is highly injurious to the sight, and, I should think, easily dispersed by the winds. The whole of the western shores is bounded by ridges of barren hills, beyond which stretches the Great Desert of Utah.

Very different, however, is the aspect of the great valley of the Wahsatch Mountains, east of the Mormon City. Here the declivities are generally covered with verdure; numerous small streams of fresh water descending from the summits, carry down with them the disintegrated particles of the feldspathic rocks above, which they deposit along the

sides of the hills, and sometimes as far down as their base, forming the small meadows above mentioned. These feldspathic particles, mixed with vegetable mould and the detritus of the limestone of which the mountain slopes are principally composed, forms with them a rich and light soil; which, absorbing moisture rapidly, is very productive of vegetation, and adapted to almost every kind of culture.

This line of deposit is narrow, and not continuous. Opposite the Great Salt Lake City, which lies in the centre of the fertile valley of the Wahsatch Mountains, it occupies the entire space from the mountains to the shores of the Lake. The arable lands thereon, from Bear River, its northern terminus, to the Mormon City, and those situated above, along the right bank of the River Jordan, are estimated by Major Stansbury at about 744 square miles, perhaps the richest lands of Utah. To these must be added some plots of good soil, abundantly covered with verdure, on Antelope, Stansbury and Carrington Islands, and on the great northern promontory. This is about all the lands susceptible of affording vegetation in the whole of that extensive area, constituting the Basin of the Great Salt Lake.

The characters of the soil of that very strange region, may, therefore, be stated as follows:—1st, Immense flats of sandy plains, highly saline and mostly sterile, producing but a few hardy grayish-looking plants peculiar to such soils. 2d, Rocky summits of mountains, equally denuded of vegetation. Lastly, fertile valleys on the declivities of the mountains and on the islands and promontories of the Lake, all possessing a soil almost homogeneous in its chemical constitution, and affording fully the nine-tenths of the limited number of distinct species composing the Flora of the Great Salt Lake Basin.

To this identity of soil, of exposure and of atmospheric influence in these fertile sections, are we to look for the true causes of the remarkably small number of species belonging to this Flora. Otherwise, these species do not seem to be affected by the saline emanations, and resemble in their general characters those collected by Mr. Nuttall, on the Valleys of the Wallawalla; by the Rev. Spalding, on those of the Sweet Water River, and by other botanical collectors on the ridges of the Snake River and other slopes of the Blue Mountains of Oregon.

In the following sketch in which I have embodied the four collections made by Messrs. Fremont,* Stansbury, Beckwith, and by Mrs. Carrington, I do not pretend to give a full enumeration of the actual botany of the Salt Lake Basin; but I am confident that they contain the greater portion of the plants growing in that region. I expect, moreover, to obtain from the same source some additional materials, which may form hereafter the subject of a supplement to the present sketch.

* I must say that the specimens brought by Colonel Fremont from the regions of Oregon and California, had been greatly injured by the difficulties and accidents of the voyage, and many therefore could not be properly examined by Dr. Torrey.

Philadelphia, March 1*st*, 1859.

DESCRIPTIONS OF THE SPECIES CONSTITUTING THE BOTANY OF THE BASIN OF THE GREAT SALT LAKE OF UTAH, AS FAR AS IT IS KNOWN.

RANUNCULACEÆ.

ANEMONE *Pennsylvanica.* Linn. Torr. and Gr., fl. 1, p. 14. Wind Flower, leaves, 3—5, parted, on long petioles; segments oblong; incisely toothed at the apex; involucre and involucels similar, two-leaved, sessile. Flowers white, about one inch in diameter. May and June. Great Salt Lake Valley. Maj. Stansbury.

DELPHINIUM *azureum.* Mich. Torr and Gr., fl. 1, p. 32. (Larkspur.) Leaves, 3—5, parted, many-cleft, with linear lobes; Petals shorter than the Sepals, the lower ones deeply two-cleft and densely bearded. Flowers azure. May. Great Salt Lake Valley. Maj. Stansbury.

Var. δ., Torr. & Gr., Fl. 1, p. 32. Densely velutinous; flowers pale-blue, almost white; Sepals with a brown pubescent spot. Great Salt Lake City. Mrs. Carrington.

D. *Menziesii,* Hook, fl. Bor. Am. 1, p. 25. Torr. & Gr., fl., suppl., p. 661. Stem 6—12 inches high; leaves five-parted; the divisions two to three-cleft, lobes mostly linear, entire. Flowers on long pedicels, large, violet-blue colour, upper petals whitish. May and June. Near the Great Salt Lake. Lt. Beckwith.

Lt. Beckwith's specimen apparently a white-flowered variety. Torr.

BERBERIDACEÆ.

BERBERIS (Mahonia) *aquifolium,* Pursh. fl. 1, p. 219, f. 4. Torr. & Gr., fl. 1, p. 50, (Barberry.) Leaflets 3—6 pairs, coriaceous, unequilateral, or slightly cordate at base, one-nerved, the margin repand with spinulose teeth; racemes short; flower yellow; berries dark purple. On the sides of the mountains, near the Lake. May. Maj. Stansbury.

PAPAVERACEÆ.

ARGEMONE *hispida,* Gray, Pl. Fendl. p. 5. (Prickly Poppy) Stem 1—2 feet high, densely setose and hoary throughout, with a short and close hirsute pubescence; flower white, 3—4 inches in diameter; capsule covered with strong spines (called Thistly Plant by the inhabitants,) flowers early in the spring. Mountain-sides near the Lake, Maj. Stansbury.

FUMARIACEÆ.

CORYDALIS *aurea,* Willd. Torr. & Gr., fl. 1, p. 68 (Golden Corydalis.) Stem 6—8 inches high; leaves slender, finely divided; racemes terminal and opposite to the leaves; flowers golden-yellow. July. Stansbury Island. Maj. Stansbury.

CRUCIFERÆ.

STREPTHANTUS *Sagittatus*, Nutt. in Torr. & Gr., fl. 1, p. 76. Smooth, and branched above, with leaves oblong, acute, sagittate, and clasping; flowers lilac-red, not spotted. May. Shores of the Lake, Maj. Stansbury. Yoab Valley, Mrs. Carrington.

S. . . . *Crassicaulis*, Torr. in Stansb. Rep., p. 348, T. 1. Stem inflated, hollow; leaves mostly radical, deeply pinnatifid, the terminal lobe much larger than the others, and triangular-deltoid. May. Eastern Shore of the Great Salt Lake, Maj. Stansbury.

CARDAMINE *rhomboidea?* D. C., (a poor specimen,) cauline leaves sessile, round-oval and somewhat hirsute; flowers yellowish-white; silique linear, 4—6 seeded. May. Yoab Valley, Mrs. Carrington.

SISYMBRIUM *canescens*, Nutt. in Torr. & Gr., fl. 1, 92. (Tansey-Mustard.) Leaves bipinnatifid, lobes oblong-lanceolate, somewhat toothed. Siliques in elongated racemes, half as long as the pedicels. May. Western Shores of the Salt Lake, Maj. Stansbury.

ERYSIMUM *asperum*, D. C. Torr. & Gr., fl. 1, p. 95. (Wall-Flower.) Stem 12—18 inches high, canescent, with a scabrous appressed pubescence; cauline leaves linear-lanceolate entire; radical ones runcinate; flowers large, fragrant, yellow. Rocky soil. May. Eastern Shores of the Lake, Lt. Beckwith, and Mrs. Carrington.

. . . . Var. *Purshii*. The very same form as Pursh's specimen in herbarium of Phila. Acad. of Nat. Sci. Stems simple, several from the same root, smaller than the preceding, scarcely 1 foot high, few-flowered; radical leaves entire, or nearly so; siliques 1½—2 inches long. June. Great Salt Lake Valley, Mrs. Carrington.

LEPIDIUM *intermedium*, Gray, Pl. Wright, No. 2, p. 15. (Peppergrass.) Upper leaves linear, entire, glabrous or nearly so, and resembling slender forms of *L. Virginicum*. May. Valley of Utah, Mrs. Carrington.

L. . . . . *corymbosum*, Hook & Arn. Bot. Beech. *L. montanum*, Nutt. in Torr. & Gr., fl. 1, p. 116. Corymbosely branched from the root; stem purpurescent; radical leaves pinnatifid, or bipinnatifid; flowers rather conspicuous, white and crowded; silicles elliptical, scarcely emarginate, wingless. July. Valley of the Wahsatch mountains, Mrs. Carrington.

CAPPARIDACEÆ.

CLEOME *lutea*, Hook. fl. Bor. Am. 1, p. 70, T. 25. *Cleome aurea?* Nutt. Leaves five foliate, leaflets narrowly lanceolate, entire; petals yellow; pods oblong-lanceolate, about the length of the stipe. June. Carrington Island, Maj. Stansbury.

VIOLACEÆ.

VIOLA *palustris*, Linn. Torr. & Gr., fl. 1, 139. Leaves reniform-cordate; stipules broadly ovate, acuminate; rhizoma articulated, somewhat scaly; flower of a pale lilac colour,

smaller than those of *V. cuculata*. May. Yoab Valley, and Great Salt Lake City, Mrs. Carrington.

V. . . . *pedunculata*, Tor. & Gr., fl. 1, p. 141. Caulescent. Leaves rhomboid-ovate, crenately toothed, abruptly narrowed at the base into a petiole; flower large, deep yellow; petals broadly obovate, the two upper with conspicuous claws, lateral ones bearded at base; spur very short. Borders of the Great Salt Lake, Maj. Stansbury.

PORTULACACEÆ.

LEWISIA *rediviva*, Pursh. fl. 1, p. 366, Torr. & Gr., Suppl. p. 677. Root thick, fusiform and branching, covered with a brownish bark; leaves densely imbricate on the short thick caudex, succulent, linear-oblong; scape short, fleshy, articulated above the middle, bearing a single flower with an involucre of 5—7 subulate scales. Flower large, petals 8—12, oblong-linear, rose-coloured. A very singular plant, called by the Indians *Spoetlum*, or *Spatulum*. The root is largely employed as an article of food. Stripped of its bark, the white inner portion is boiled in water, and forms a substance similar to sago, or arrow-root. Yoab Valley, Mrs. Carrington.

LINACEÆ.

LINUM *perenne*, Linn. Torr. & Gr., fl. 1, p. 204. (Flax.) Leaves alternate, linear-acute; flowers terminal, blue; sepals oval, with membranaceous margins, three to five-nerved. Yoab Valley, Mrs. Carrington.

GERANIACEÆ.

ERODIUM *cicutarium*, L'Her. Torr. & Gr., fl. 1, p. 208. (Storksbill.) Stem prostrate; leaves pinnately divided, segments pinnatifid, incised or acute; flowers umbellate, light-purple colour. Islands of the Great Salt Lake. June. Maj. Stansbury.

ANACARDIACEÆ.

RHUS. . . . . (Sumach.) A species of Rhus, not collected, is mentioned by Col. Fremont as forming thickets at the north end of the Salt Lake.

MALVACEÆ.

SIDALCEA *malvæflora*, Gray, Pl. Wright, 1, p. 16. A plant 2—8 feet high, with purple flowers. Radical leaves orbicular, lobed or incisely crenate; cauline ones 3—5 parted, segments three-lobed, dentate at top. Raceme multiflore. June. Antelope Island, Maj. Stansbury.

MALVASTRUM *coccineum*, Gray, Pl. Fendl. p. 24.

Var. *grossulariæfolium*, Torr. in Maj. Stansb. Rep., p. 384. Stems very pubescent, 15—20 inches high; leaves on long petioles, deeply three to five-parted; segments three-cleft; racemes 3—4 inches long, terminal, many-flowered, shortly pedunculate, light-

red. Islands and shores of the Great Salt Lake. June. Col. Fremont, Maj. Stansbury, and Mrs. Carrington.

BOMBACEÆ.

Sarcobatus Vermiculatus, Torr. in Emory's Report, p. 149. *S. Maximiliani*, Nees; *Fremontia Vermicularis*, Torr. in Pl. Frem. Smithson. Contr. vi., p. 6. *Batis Vermicularis*, Hook. fl. Bor. Am. 2, p. 188. A curious thorny shrub, 6—8 feet high, having much the habit of *Hibiscus Syriacus*, and found in saline soils, where it occupies almost exclusively the bottom of neighbouring streams; it is eminently a saline shrub, and its leaves have a very salt taste. Stem diffusely branched; flowers dioicious, in terminal ovoid aments, the staminate flowers at the summit; leaves alternate, linear, fleshy, almost terete, 6—12 lines long; calyx broadly campanulate, five-parted; no corolla; stamens five, short; ovary five-celled, hairy. It abounds on certain parts of the shores of the Great Salt Lake, and at Strong's Knob. Maj. Stansbury. (Called Pulpy Thorn by Lewis and Clark.)

LEGUMINOSÆ.

Cicer *arietinum*, Linn. (Chick-Pea.) Stem angled, slightly villous; leaflets 15—17, oval, dentate; peduncles axillary, one-flowered; flowers purplish or white. Perhaps introduced? Salt Lake Valley, Maj. Stansbury.

Vicia *Americana*, Muhl. Torr. & Gr., fl. 1, p. 269. (Vetch.) Leaflets 10—14, elliptical, obtuse, mucronate, strongly reticulated, with undulating margins; peduncles shorter than the leaves, four to eight-flowered; flowers purplish-blue. June. Great Salt Lake Valley, Maj. Stansbury, Mrs. Carrington.

V. . . . *Oregona*, Nutt. in Torr. & Gr., fl. 1, p. 270. Stem weak and pubescent, 10—15 inches high; leaflets 6—8 pairs, elliptical-oblong, cuspidate, strongly veined; peduncles three to five-flowered, rather shorter than the leaves. Flowers smaller than the preceding. Fillmore City, Mrs. Carrington.

Lathyrus *polyphyllus*, Nutt. in Torr. & Gr., fl. 1, p. 247. (Vetchling.) A robust plant, with erect and angled stem. Leaflets 5—8 pairs, oblong, veined, obtuse, 2—2½ inches long (in my specimens;) peduncles shorter than the leaves; flowers rather small, light-purple. Valley of the Great Salt Lake, Mrs. Carrington.

L. . . . *Venosus*, Muhl. Torr. & Gr., fl. 1, p. 274. Var. Leaflets broadly ovate, almost round, strongly veined, 5—7 pairs; peduncle five to ten-flowered, about as long as the leaves; flowers rather large, purplish. Great Salt Lake Valley. June. Mrs. Carrington.

Psoralea *argophylla*, Pursh, Torr. & Gr., fl. 1, p. 301. Erect, divaricately branched; leaves three to five-foliate; spike pedunculate, interrupted; lower teeth of the calyx longer than the flower. The whole plant very silky-silvery. July. Mrs. Carrington.

GLYCYRRHIZA *lepidota*, Nutt. Torr. & Gr., fl. 1, 249. (Liquorice.) Stems 2—5 feet high; flowers whitish, in pedunculate spikes; legume densely beset with prickles; root long, creeping, with the taste of liquorice. Northern extremity of the Great Salt Lake, Col. Fremont.

ASTRAGALUS *adsurgens*, Pall. Torr. & Gr., fl. 1, p. 330. (Milk-Vetch.) Stem elongated, ascending or prostrate; leaflets 7—12 pairs, oblong, obtuse, pale green; flower white shaded with purple. Western Shore of the Great Salt Lake, Maj. Stansbury.

A. . . . . *Beckwithii*, Torr. in Lt. Beckwith's Rep., p. 120. Stems branching from the base, slender, 6—8 inches high; peduncles about the length of the leaves, 5—7 flowered; calyx oblong, campanulate, with subulate teeth. South of the Great Salt Lake, Lt. Beckwith; and Eastern Valley, Mrs. Carrington.

A. . . . . *Purshii*, Dougl. in Hook., fl. Bor. Am. 1, p. 152. *Phaca mollissima*, Nutt. in Torr. & Gr., fl. 1, p. 350. Almost stemless, densely covered with white silky hairs. Leaves petiolate; leaflets 4—6 pairs, ovate, obtuse; peduncles shorter than the leaves, three to five-flowered; flowers pale-purple, one inch or more in length, the calyx about two-thirds the length of the corolla; pods rather large, covered with fine yellowish-white wool. May. Mrs. Carrington.

A. . . . . *Utahensis*, Torr. in Beckw. Rep., p. 120. *Phaca mollissima*. Var. *Utahensis*, Torr. in Stansb. Rep., p. 385, fig. 2. Densely white-tomentose; stems decumbent, short, Torr. (in my specimens 6—8 inches long;) leaflets 6—9 pairs, broadly ovate, or nearly orbicular; peduncles equalling, or generally exceeding the leaves; subcapitulately three to six-flowered; flowers rather large, violet-purple. Legume sessile, extremely woolly, strictly one-celled. Shores and Islands of the Great Salt Lake, Maj. Stansbury, Lt. Beckwith, and Mrs. Carrington who remarks that it flowers several times a season.

A. . . . . *diphysus?* Gray, Pl. Fendl., p. 34. Torr. in Beckw. Rep., p. 120. "Only in flower, not accurately determined." South-western end of the Great Salt Lake, Lt. Beckwith.

A. . . . . Specimens in a bad state, and too young. Stems slightly pilose, several from the same root, 4—6 inches high; leaflets 7—10 pairs, small, obtuse or emarginate; peduncles shorter than the leaves, few-flowered. Great Salt Lake Valley, Mrs. Carrington.

HEDYSARUM *boreale?* Nutt. Gen. 2, p. 100. Torr. & Gr. fl. 1, p. 356. (Sainfoin.) I cannot but consider *H. boreale* & *H. canescens* of Nuttall, and *H. Mackensii* of Richardson, as forms of the same species, which it is impossible to separate. Mrs. Carrington's specimens seem to be larger than any heretofore described. She remarks that her plant is 2 feet high, but from the long decumbent branches, at least 15 inches in length, which she has sent, I should judge it must be somewhat higher. The whole plant is glaucous, slightly canescent

and quite decumbent; the stem is thick, hollow, striate and pubescent; the leaflets about 8 pairs with an impair, oval-oblong and veinless; peduncles much longer than the leaves with a raceme of 15—25, purplish-blue flowers; shortly pedicellate, with a small bract at the base of the pedicel; calyx short, villous, with subulate teeth; vexillum and wings shorter than the keel: joints of the legume 3—4, nearly orbicular.

Prof. Torrey in Stansbury's Report, p. 385, mentions *H. Mackensii*, (undoubtedly the same plant,) as found on Promontory Range of the Great Salt Lake. Mrs. Carrington's plant appears so luxuriant and tender, that it will likely prove in cultivation a very valuable food for cattle, as the generality of the sainfoins are. Great Salt Lake City, June 1st.

Lupinus *decumbens*. Var. *argophyllus*, Gray, Pl. Fendl., p. 37. The whole plant clothed with short silvery hairs; leaves on long petioles; leaflets 6—8, lanceolate acute, slightly mucronate; peduncles longer than the leaves; raceme elongated; flowers rather small, rose color mixed with purple. Mrs. Carrington.

L. *albicaulis*, Dougl. in Torr. & Gr. fl. 1., p. 378. *L. falcifer*, Nutt. A larger species than the preceding and scarcely distinguishable from it, except by its elongated and falcate keel. Antelope Island. June. Major Stansbury.

ROSACEÆ.

Spiræa *dumosa*, Nutt. in Hook., London Jour. Bot. VI., p. 217. Torr. in Stansb. Rep. fig. t. IV. A small shrub irregularly branching, with small sublobate or serrate leaves; widening at top and cuneate at base. Racemes in crowded panicles; carpels 5. Stansbury Island, Major Stansbury.

S. . . . . *Opulifolia*. Var. *pauciflora*, Torr. & Gr., fl. 1., p. 414. Leaves small roundish, three-lobed, nearly glabrous; corymbs pedunculated, few-flowered; carpels 1, 2—4, tomentose. Summit of mountain in Stansbury Island. May. Maj. Stansbury.

Cowania *Stansburyana*, Torr. in Stansb. Rep., p. 368, T. III. A shrub 6—12 feet high, much branched; leaves growing from short spurs 4—6 lines long and deeply cut in 5—7 lobes, partly tomentose underneath; flowers solitary, terminal; calyx turbinate, glandular, with broadly obtuse segments; petals sulphur-yellow, broadly obovate, longer than the calyx; style persistent, and, in fruit, 1 inch and more in length and beautifully plumose. Stansbury Island, Major Stansbury.

Potentilla *gracilis*, var. *flabelliformis*. Nutt. in Torr. and Gr., fl. 1., p. 440. Cinque Foil. Stem 15—20 inches high, villous-pubescent, leaves palmate, 5—9 foliate, leaflets deeply pinnatifid, the lobes linear-lanceolate: flowers yellow, abundant in Yuba Valley. May and June, Mrs. Carrington.

Rosa. . . . Major Stansbury mentions in his report, to have seen rose bushes in the meadows at the foot of the mountain on the eastern shores of the lake.

Cratægus. . . . (Hawthorn.) A species of cratægus was observed by Col. Fremont at the northern end of the Great Salt Lake.

ONAGRACEÆ.

ŒNOTHERA *cæspitosa.* Torr. and Gr., fl. 1., p. 500. (Evening Primrose.) Shores and Islands of Great Salt Lake, Major Stansbury.

Var. *montana.* Œ. montana, Nutt. in Torr. and Gr., fl. 1, p. 500. Stemless and cæspitose; leaves lanceolate, sinuate-toothed, tapering into a petiole, expanding at base; margins quite woolly; flowers large, white and red. As Dr. Torrey remarks at page 387 of Stansb. Report, the three species of Nuttall forming the group *Pachylophis* of Spach, should be thrown into one species. They seem to differ only by the capsule being nearly sessile in *œ. cæspitosa;* quite sessile, in *œ. montana* and pedicellate in *œ. marginata.* Valley of the Great Salt Lake, Mrs. Carrington.

Œ. . . . *albicaulis,* Nutt. in Torr. and Gr., fl. 1, p. 495. One foot high or more, erect, branching at top, glabrous, whitish; leaves narrow-lanceolate, mostly entire or remotely toothed: flowers axillary, rather small, white, drying purple. Islands and Valley of the Great Salt Lake. June. Major Stansbury and Mrs. Carrington.

Œ. . . . *Scapoidea,* Nutt. in Torr. and Gr., fl. 1, p. 506. A very diminutive plant with a few ovate radical leaves, obscurely denticulate, on a petiole about the length of the limb; scape 3—4 inches, usually naked, bearing 6—13 very small flowers on slender pedicels with minute bracts. Capsule very large in proportion to the flower. Western shores of the Salt Lake. May. Major Stansbury.

GAYOPHYTUM *ramosissimum.* Torr. and Gr., fl. 1, p. 513. A small and divaricately branched plant with very small flowers at the extremity of the branches, resembling those of *œnothera scapoidea;* capsule short, linear-clavate, shorter than the capillary pedicels. Antelope Island. Major Stansbury.

LOASACEA.

MENTZELIA *albicaulis.* Dougl. in Torr. and Gr., fl. 1, p. 534. *Bartonia albicaulis.* Hook, fl. Bor. Am., 1, p. 222. Stem white and polished, branching from the base, nearly glabrous below, leaves lanceolate, deeply sinuate-pinnatifid, sessile, remote; flowers small, not bracteolate, yellow. Valley of the Great Salt Lake. Major Stansbury.

M. . . . *Ornata.* Torr. and Gr., fl. 1, p. 534. *Bartonia ornata.* Nutt. Stem 2—4 feet high, with short barded hairs, much branched, leaves sessile, oblong-lanceolate, sinuate-pinnatifid, flowers very large, yellowish-white, odorous and vespertine. Islands; of the Great Salt Lake. Major Stansbury.

CACTACEA.

Several species of *cactus* or *opuntia* were seen by Major Stansbury on Antelope Island, and one with very long spines, at the northern extremity of the Lake.

SAXIFRAGACEÆ.

HEUCHERA *rubescens*. Torr. in Stansb. Rep., p. 388, t. V. Scape naked, glabrous. Leaves suborbicular, 5—7 lobed; lobes crenate, dentate; flowers 15—25, loosely paniculated in remote branchlets with a small bract at the base of the pedicel. Rhizoma thick, somewhat ligneous, clothed with the brown vestiges of anterior leaves. June. Stansbury Island, Major Stansbury.

UMBELLIFERÆ.

THASPIUM *cordatum*. Torr. and Gr., fl. 1, p. 615. (Meadow Parsnip.) Radical leaves simple, cordate; cauline ones ternately divided, the segments oval, serrate; winged ribs of the carpels equal; flowers yellow. May. Yoab Valley, Mrs. Carrington.

T. . . . . *montanum*. Gray, Pl. Fendl., p. 57. Stems 5—8 inches high; leaves 2—3, pinnatifidly cut with oblong, acute, entire or incised lobes; flowers yellow, in dense umbels, with numerous rays. May 25th. On a mountain bordering the Salt Lake, Maj. Stansbury.

PEUCEDANUM *triternatum*. Nutt. Torr. and Gr., fl. 1, p. 626.

Var. *platycarpum*. Torr. in Stansb. Rep., p. 389. Root tuberous, large and somewhat fusiform. Stems 1—2 feet high; leaves 2—3, ternately divided, segments of the leaves 1—3 inches long, 1—3 lines wide, peduncles very long, flowers polygamous or dioicious; fruit obovate, very broadly winged, much more so than Nuttall's plant. Valley of the Great Salt Lake, Major Stansbury.

Leptotænia. . . . . A species of this genus was observed by Colonel Fremont on the north side of the Lake.

VALERIANACEÆ.

VALERIANA *edulis*. Nutt. in Torr. and Gr., fl. 2, p. 48. (Valerian.) Root fusiform, fleshy; stems erect; lower leaves entire, linear-lanceolate, or 1—2, pinnately parted with divaricate lobes; the cauline deeply pinnatifid with ciliate linear segments.

The specimen which I have received, is only the upper part of a stout stem, about 10 inches long, bearing a long panicle of flowers, fully one half of its length, the two lower cymules of which are pedicellate and interrupted. All the cymules are very much crowded with flowers. At the base of the panicle are two opposite leaves, palmately pinnatifid, with dilated petioles, and three inches below these, another set of opposite leaves, much larger, but of the same form, with lanceolate-linear divisions 1 inch long and finely ciliate. May. Mrs. Carrington and Colonel Fremont.

The root is called by the natives *Kooyan;* when baked on heated stones or steamed under ground, it is converted into a pulpy mass, sweet and rather agreeable to the taste, which furnishes food to the aborigines.

COMPOSITÆ.

EUPATORIUM *purpureum*. Linn. Torr. and Gr., fl. 2, p. 81. (Thoroughwort.) Stem stout, simple, fistular; leaves verticillate, oblong-ovate or lanceolate, veined, scabrous or glabrous above, serrate with mucronate teeth. Heads in large compound corymbs of purple or flesh-colour flowers. Northern end of the Great Salt Lake, Colonel Fremont.

ASTER *oblongifolius*. Nutt. in Torr. and Gr., fl. 2, p. 143. (Starwort.) Stem much branched, somewhat hairy; branchlets loosely paniculate-corymbose; leaves narrowly oblong or lanceolate, partly clasping, mucronulate scales of the involucre numerous, somewhat glandular, with elongated and squarrose-foliaceous summits; achenia caulescent. June. Stansbury Island, Major Stansbury.

ERIGERON *macranthum*. Nutt. in Torr. and Gr., fl. 2, p. 173. (Fleabane.) Stem leafy to the summit; leaves glabrous, with ciliate margins, the lowermost spathulate, tapering into a petiole; the upper sessile, partly clasping, oblong-obovate or elliptical, obtuse; flowers rather large, with purplish-blue ligules. June. Great Salt Lake Valley, Mrs. Carrington.

E. . . . . *concinnum*. Torr. and Gr., fl. 2, p. 174. Very hirsute throughout. Stems several from the same root, slender, leafy and branching above, the branches terminating by single heads on long peduncles; leaves narrowly linear, entire, the lowermost tapering into a petiole; rays white or pale blue, numerous, in a single series; involucre very hirsute. Great Salt Lake Valley, Major Stansbury, Mrs. Carrington.

Small undeveloped specimens of the above, 2—3 inches high, from Mrs. Carrington's collection, might be mistaken for *E. pumilum* of Nuttall.

LINOSYRIS *serrulata*. Torr. in Stansb., Rep. p. 389. Leaves narrowly linear, 3 nerved, rigid, acute, serrulate; heads fastigiate, corymbose, subquadriflore; scales imbricated in 4—5 series, oblong-lanceolate, spreading, the exterior ones shorter. Valley of the Great Salt Lake, Major Stansbury.

L. . . . . *graveolens*, Torr. and Gr., fl. 2, p. 234. Shrubby and much branched; leaves very narrowly linear, glabrous, uninerved; heads five-flowered, clustered; scales of the involucre few, loosely imbricated in about 3 series, glabrous, carinate; the outermost very short, oblong-ovate; the others elongated, linear. Northern extremity of the Great Salt Lake. Col. Fremont.

LAPHAMIA *Stansburyi*, Gray, Pl. Wrightianæ, part 1, p. 101. Stems nearly a foot high; heads three lines long, and as broad; scales of the involucre about fifteen, lanceolate-oblong; branches of the style filiform-subulate. Near the Great Salt Lake, Capt. Stansbury.

STENOTUS *cœspitosus*. Nutt. in Torr. and Gr., fl. 2, p. 238. A small plant, 4—6 inches

high; leaves crowded at the summit of the woody caudex, narrowly lanceolate or linear, acute, three-nerved; those of the stem or branching scapes, few. Flowers bright yellow; scales of the involucre in three series, broadly obovate, erose-ciliate. Valley of the Salt Lake, Major Stansbury.

Grindelia *squarrosa*, Dunal. Torr and Gr., fl. 2, p. 247. Corymbosely branched, glabrous; leaves oblong-lanceolate, obtuse, finely serrate, somewhat clasping; scales of the glutinous involucre with recurved-squarrose, or mostly circinate subulate tips. Heads small, numerous, yellow. Near the hot and cold springs at the mouth of Bear River, May, Major Stansbury.

Ambrosia *coronopifolia*. Torr. and Gr., fl. 2, p. 291. (Ragweed.) Stem 1—5 feet high, canescently strigose. Leaves 2—5 inches long, clothed with very appressed hairs; the upper sessile, lanceolate, deeply incised or pinnatifid; the lower somewhat bipinnatifid, on short margined petioles. Sterile heads in loose spicate racemes; fertile ones, solitary or several clustered at the base of the sterile spike. Fruit globose-ovoid. Table land at the northern extremity of Salt Lake Valley, Major Stansbury.

Balsamorhiza *hirsuta*. Nutt. Hirsute. Leaves very long, lanceolate, pinnately divided, the divisions oval or oblong, entire or incised, the lower pinnatifid; scape naked, 6—12 inches high, bearing a single and very large head, of yellow flowers. The root of this plant, when wounded, exudes a copious liquid resin, which has a strong odour of turpentine. Utah Valley, May, Mrs. Carrington.

Lepachys *columnaris*. Torr. and Gr., fl. 2, p. 315. Primordial leaves undivided; those of the stem pinnately parted, segments linear-lanceolate, entire, rarely lobed. Disk columnar, one inch and more long, rays yellow and recurved. In sandy soil, Mrs. Carrington.

Monotrix *Stansburiana*. Torr. in Stansb. Rep., p. 390, t. VII. About a span high, and minutely glandular-pubescent. Lower part of the stem ligneous, branches herbaceous. Leaves small, broadly ovate, with a few coarse teeth somewhat lobed. Head hemispheric, radiate. Scales of the involucre glandularly puberulous, in 3 series. Disk-flowers four-toothed, those of the ray short and three-toothed. In the crevices of limestone rocks in Stansbury Island. June. Major Stansbury.

Chenactis *stevioides*. Hook. and Arn., Torr. and Gr., fl. 2, p. 371. Stem very low, corymbosely branched. Leaves when young, somewhat woolly, pinnately divided, the divisions linear, obtuse, entire or sometimes pinnatifid. Involucre glandular, puberulent; flowers white or flesh colour. Strong's Knob, Major Stansbury.

C. . . . . *achilleæfolia*. Hook. and Arn., Torrey in Stansb. Rep., p. 390, t. VI. Stem about a span high; leaves somewhat fleshy and clothed with a white tomentum,

the lobes very small, obtuse, and much crowded. Head few in a terminal corymb; flowers of the ray and disk nearly alike, funnel form. Pappus of about ten oblong, obtuse, denticulate scales, five of which in the disk flowers, are nearly as long as the tube of the corolla, and the other five about half as long. Stansbury Island, June. Major Stansbury.

LAYIA *glandulosa.* Hook. and Arn., Torr. and Gr., fl. 2, p. 394. About one foot high, erect and hispid towards the base; leaves broadly linear, entire; peduncles of the cauline leaves and involucre glandular; heads large, rays white, 3—cleft, double the length of the involucre. Valley of the Great Salt Lake, Major Stansbury.

ACHILLEA *millefolium,* Linn. Torr. and Gr., fl. 2, p. 409. (Yarrow.) Islands of the Salt Lake, Major Stansbury.

. . . . Var. *lanata,* Koch. Densely woolly, with finely bipinnately parted leaves; heads rather larger than the common species; the whole plant bearing a whitish tomentose appearance. Great Salt Lake City, Mrs. Carrington.

ARTEMISIA————————(generally called Sage or Wormwood.) The genus *Artemisia* is extensively spread in the Western regions; not less than thirty distinct species have already been described as belonging to Oregon and California, several of which are hardy and shrubby plants from 3 to 6 feet high. Col. Fremont, Maj. Stansbury and Lieut. Beckwith speak of large patches of *Artemisia* on the flats of the Great Salt Lake; but, as far as I know, they have brought no specimens to permit us to ascertain to what species of this genus this *Artemisia* belongs. It is probable that it is one or several of the four species enumerated by Dr. Torrey, as found by Maj. Stansbury on the shores of the Green River, 160 miles from the Great Salt Lake City, viz.: *A. tridentata, A. frigida, A. Ludoviciana, A. Canadensis.*

SENECIO *Hookeri.* Torr. and Gr., fl. 2, p. 438. (Groundsel.) Stem simple, 6—12 inches high; radical and lowest cauline leaves ovate or spathulate-oblong, repand-denticulate or entire, contracted into a short margined petiole; the upper leaves lanceolate, entire, sessile; scale of the involucre nearly glabrous. Flowers rather small; rays bright yellow. Mouth of Weber River. May. Major Stansbury.

S. . . . . *hydrophyllus.* Nutt. in Torr. and Gr., fl. 2, p. 440. Stem simple, striate, very glabrous, rather leafy, leaves lanceolate, entire or obsolately repand-denticulate; the radical and lowest cauline elongated, tapering into a thickish somewhat clasping petiole. Heads in a compound naked corymb; rays 3—6, very small; the tips of the involucral scales purplish. Valley of the Salt Lake, Maj. Stansbury.

S. . . . . *filifolius* Nutt. in Torr. and Gr., fl. 2, p. 444. Suffruticose and much branched, the branches diffuse, very leafy to the summit. Leaves pinnately 5—9 parted, segments very narrowly linear with revolute margins; heads rather large, rays 6—8, linear, elongated. Valley of the Salt Lake, Major Stansbury.

S. . . . . *eremophyllus.* Richards. in Torr. and Gr., fl. 2, p. 444. Stem glabrous, striate, 15—20 inches high; leaves interruptedly pinnatifid, the segments unequal with a few teeth. Heads in a loose compound corymb, somewhat larger than those of *S. aureus,* which it resembles much. Great Salt Lake County, April. Mrs. Carrington.

Tetradymia *Nuttallii.* Torr. and Gr., fl. 2, p. 447. Shrubby and much branched, 2—3 feet high. Primary leaves mostly converted into subulate spines, the other densely fascicled in their axils, thickish, linear-spathulate, obtuse, covered with a deciduous tomentum. Heads fascicled in corymbose clusters on very short peduncles, bright yellow. Shores of the Salt Lake, May. Major Stansbury.

Cirsium *undulatum,* Spreng. Torr. and Gr., fl. 2, p. 456. (Plumed Thistle.) Canescently tomentose throughout. Stem low, angled, branched above; branches bearing a solitary head; leaves lanceolate-oblong, sinuate-pinnatifid, very white and tomentose beneath; involucre sub-globose, with lanceolate appressed scales tipped with a weak spreading prickle; flowers large, reddish-purple. Stansbury Island, June. Major Stansbury.

Stephanomeria *runcinata.* Nutt. in Torr. and Gr., fl. 2, p. 472. Stem 4—8 inches high with flexuous striate branches. Radical and lower cauline leaves runcinate, those of the fertile branches linear-subulate; head 5—6 flowered; involucre cylindrical; flowers rose colour. Carrington Island, Major Stansbury.

Ligodesmia *juncea.* Don. in Torr. and Gr., fl. 2, p. 484. 15—20 inches high, very glaucous; stem branched, striate; lower leaves linear-sublanceolate, rigid; the upper subulate; head five-flowered, large, fully 1½ inch long, with an elongated cylindrical involucre of 5—6 scales; ligules double the length of the scales, finely dentate at top, lilac colour. It is the same large flowered form mentioned by Prof. Torrey in Stansb. Rep., p. 392. It is larger in all its parts than any other specimens of the same species, that I have seen. The lower stem leaves are 4—5 inches long. The whole plant is very smooth and whitish, and grows in various soils on the Islands and Valleys of the Great Salt Lake. Major Stansbury and Mrs. Carrington.

Malacotrix *sonchoides.* Torr. and Gr., fl. 2, p. 486. Dwarfish, glabrous; stems branching; radical leaves linear-oblong, runcinate, with short approximate lobes spinulosely-denticulate; cauline leaves small and scattered; heads of 30—40 small flowers; exterior scales of the involucre erose-denticulate; flowers yellow. Shores of the Salt Lake and Carrington Island, Major Stansbury.

Crepis *acuminata.* Nutt. in Torr. and Gr., fl. 2, p. 489, and Torr. in Stansb. Rep., p. 392, t. viii. Stem scapiform, 1—3 feet high, sparingly leafy; radical leaves fully twelve inches long with the petiole, runcinate-pinnatifid, tapering at the base into a petiole one third of its whole length, and at the apex into a slender entire acumination. Heads cy-

lindrical, with very short scales; flowers yellow. Stansbury Island. June. Major Stansbury.

C. . . . . *occidentalis.* Nutt. in Torr. and Gr., fl. 2, p. 489. Stems scapiform, 15 inches high; radical leaves runcinate, pinnatifid, tapering into a long petiole, and both together 6—12 inches long; divisions narrowly lanceolate, acuminate, sparingly acutely dentate; the lower cauline leaves sessile and pinnately parted, the upper ones entire; heads large, 3—5 in a paniculate corymb; involucral scales in two series, the internal ones very long, narrowly lanceolate, the outer bracteolate; flowers yellow. Nuttall's specimen was a dwarfish state of this rather large plant. Salt Lake Valley, Mrs. Carrington.

Troximum *cuspidatum.* Pursh. Torr. and Gr., fl. 2, p. 489. (Acaulescent.) Leaves narrowly linear-lanceolate, acuminate, somewhat nerved, especially on the broad midrib; the often undulate margins tomentose: scales of the involucre somewhat scarious, lanceolate, cuspidate-acute, glabrous, in two equal series; flowers large, yellow. Valley of the Great Salt Lake, Major Stansbury.

T. . . . . *parviflorum.* Nutt. Torr. and Gr., fl. 2, p. 490. Villous-pubescent when young, at length glabrous; leaves narrowly linear, lanceolate, acuminate, entire, but sometimes retrorsely denticulate towards the base; scales of the glabrous involucre lanceolate, acuminate, in 2—3 series, the outer of which is bracteolate; flowers yellow. Yoab Valley, Mrs. Carrington.

ERICACEÆ.

Arctostaphylos *glauca.* Lindl. in D. C. Prodr. VII., p. 388. (Bearberry.) A shrub. Leaves glaucous, oval-oblong, acute, coriaceous and obtuse at the base; racemes short and compound; bracts squamiform; fruits ovate. Pauvan Valley, Mrs. Carrington.

PRIMULACEÆ.

Dodecatheon *integrifolium.* Var. minus? Hook., fl. Bor. Am. 2, p. 118. A miniature form with flowers scarcely one-third of an inch from the summit of the reflexed divisions of the white corolla to the tip of the anthers; scape and pedicels purplish, the latter very short and reflexed only in the full expansion of the flowers; involucre of five short folioles, broadly ovate and approximate in the form of a truncated funnel; filaments yellow, and free immediately below the purple-blue anthers, which are all divergent: capsules not seen; leaves oval-oblong, entire, tapering at the base into a narrow petiole; petiole and limb 2½—3 inches long. Rich soil on the banks of Leven River, Salt Lake Valley, May 15th, Mrs. Carrington.

OROBANCHACEÆ.

Aphylon *fasciculatum.* Torr. and Gr. in Gray's Man., p. 281. *Orobanche.* Nutt. *Anoplanthus,* Walp. in D. C. Prodr. X., p. 42. (Naked Broom Rape.) Pulverulent,

pubescent; stem short, scaly; peduncles fasciculate, naked, one-flowered; calyx ebracteate, lobes triangular-acute, the tube of the corolla long and re-curved; lips erect, concave, short and obtuse, the superior bifid, the inferior trifid; filaments glandular, anthers glabrous; flowers pinkish-white. Great Salt Lake City. June. Mrs. Carrington.

SCROPHULARIACEÆ.

MIMULUS *luteus*. Linn. D. C. Prodr. X., p. 370. (Monkey Flower.) Glabrous; leaves ovate-orbicular, erose-dentate, the lower longly petiolate, sublyrate, the upper sessile or cordate-amplexicaule; calyx ovate and inflated in seed, the upper tooth larger; corolla yellow, the tube at least twice the length of the calyx. Great Salt Lake Valley. June. Mrs. Carrington.

VERONICA *Americana*. Schw. D. C. Prodr. X., p. 468. (American Brook Lime.) Glabrous; leaves mostly petiolate, opposite, ovate-oblong, serrate, truncate or subcordate at base; racemes pedunculate, axillary, opposite; corolla pale blue with purple stripes; capsule rounded, turgid, notched at the top. Great Salt Lake County. April—June. Mrs. Carrington.

CASTILLEJA *hispida*. Benth. in D. C. Prodr. X. p. 532. (Painted cups.) Hispid. Stem-leaves lanceolate, mostly three cleft, divisions linear, elongated, the floral ones broader. Lobes of the calyx two cleft, the divisions oblong, almost linear, shorter than the red corolla, helmet 4—5 times longer than the inferior lip. Shores of the Salt Lake, Maj. Stansbury, and Mrs. Carrington.

C. . . . *miniata*, Dougl. in Hook. fl. Bor. Am. 2, p. 106. Glabrous, or hairy at top. Cauline leaves entire, lanceolate, floral ones incised and minium coloured. Spike dense, and sometimes becoming interrupted. Lobes of the calyx bifid with almost linear divisions; the upper lip of the corolla 4—5 times longer than the inferior one. With the preceding, Maj. Stansbury.

C. . . . *sessiliflora*, Pursh. Gray, Man. p. 294. Hairy, leaves mostly three cleft, with narrow divergent lobes, floral ones broader and scarcely coloured; spike crowded; calyx cleft in front, the divisions two cleft, shorter than the tube of the long-narrow and greenish-yellow corolla, which has the lobes of the lower lip slender and half the length of the upper lip. Mouth of Weber River, Maj. Stansbury.

BORRAGINACEÆ.

MERTENSIA *oblongifolia*, Don. D. C., Prodr. X. p. 92. (Smooth Lungwort.) Smooth, simple, erect. Leaves lanceolate-oblong; flowers paniculate, pedicellate; calyx short, with linear lobes, acute and ciliate; corolla tubular-campanulate, blue. Northern end of the Great Salt Lake, Col. Fremont.

M. . . . *Drummondii*, Don. D. C. Prodr. X. p. 89. Stem ascending, glabrous; leaves glaucous, punctate, subdenticulate; the radical ones ovate-lanceolate, petiolate; the cauline sessile, oblong-lanceolate; panicles terminal, crowded; corolla three times longer than the calyx. Salt Lake Valley, Maj. Stansbury.

AMSINCKIA *lycopsoides*, Lehm. in D. C. Prodr. X. p. 117. Stem branching; cauline leaves ovate-lanceolate; throat of the corolla hairy, the tube three times longer than the limb; stamens inserted on the tube a little above the base. Shores of the Salt Lake, Maj. Stansbury.

ERITRICHIUM *glomeratum*, D. C. Prodr. X. p. 131. (Stick-seed.) Stem erect, simple; leaves spathulate, on long petioles, hirsute. Spikelets paniculate, 5—7 flowered, axillary, conglomerate, sometimes bifid with the upper spikelet sessile. Calyx very hirsute, lobes linear-lanceolate, as long as the tube; limb of the corolla very small, yellowish-white. Valley of the Great Salt Lake, Maj. Stansbury, and Mrs. Carrington.

ECHINOSPERMUM *floribundum*, Lehm. in D. C. Prodr. X. p. 143. Stem erect, fistulous, sparingly hirsute; cauline leaves sessile, ciliate, pubescent, radical ones lanceolate, petiolate; racemes bifid, bracteolate; nutlets ovate prickly; flowers, in our specimens, white, rather large. Great Salt Lake Valley, Mrs. Carrington.

HYDROPHYLLACEÆ.

EUTOCA *heterophylla*, Torr. in Stansb. Rep. p. 393. Erect, glabrous, pubescent; leaves 2—3 inches long, subsessile, oblong-linear, entire or furnished on each side with an oblong or linear lobe; flowers blue, shortly pedicellate; lobes of the calyx ciliate, obtuse; corolla widely campanulate, almost rotate, lobes rounded, larger than the calyx, appendages ten in pairs between the bases of the filaments. Valley of the Great Salt Lake, Maj. Stansbury and Mrs. Carrington.

POLEMONIACEÆ.

PHLOX *speciosa*, Pursh. D. C. Prodr. IX. p. 307. Cœspitose, rigid, erect, glabrous. Leaves linear-subulate; base of the calyx strongly 5—nerved, pentagonal, with rigid subulate teeth; divisions of the corolla entire, obovate, cuneiform, flower pinkish. Great Salt Lake Valley, Mrs. Carrington.

P. . . . *canescens*, Torr. in Beckw. Rep. p. 122, t. VI. Dwarf, very much branched and densely cœspitose, tomentose when young and canescent. Leaves acerose, imbricated, at length recurved, spreading, not rigid, and very woolly towards the base. Flowers sessile; teeth of the calyx similar to the leaves; tube of the corolla much larger than the calyx. Mountain south of the Great Salt Lake, Lt. Beckwith. Wahsatch Mountains, Mrs. Carrington.

P. . . . *humilis*, Dougl. in D. C. Prodr. IX. p. 306. Suberect, pubescent; leaves linear-subulate, subfasciculate; divisions of the limb of the corolla obovate, mucronate. Flowers white. On a rocky mountain above the eastern valley, Mrs. Carrington.

P. . . . *Hoodii*, Richards. in Frankl. Journ. app. ed. 2, p. 6, t. 28. Dwarf, very ramose and cæspitose. Leaves linear-subulate, rigid, fasciculate, flowers sessile, the teeth of the calyx short, subulate, rigid; divisions of the corolla obovate, entire, very obtuse. Mountains on the Salt Lake, Maj. Stansbury.

Among the plants of Mrs. Carrington is a small phlox, scarcely one inch high, collected in a rocky soil, which seems to be intermediate between *P. Richardsoni* and *P. Hoodii*—but on account of its insufficiency I cannot determine its true character. I think there is yet a great confusion among these dwarfish acerose species.

P. . . . *longifolia*, Nutt. D. C. Prodr. IX. p. 307. Subcæspitose, several stems from the same root; branchlets short, irregularly trichotomous, pauciflore. Leaves subulate, very long and narrow, glabrous; peduncles filiform, elongated; divisions of the calyx acuminate, those of the corolla oblong-cuneate, entire. Mouth of Bear River, May, Maj. Stansbury.

Collomia *gracilis*. Dougl. D. C. Prodr. IX. p. 308. Very small, ramose. Leaves linear-obtuse; the lower ones ovate, oblong, opposite; the divisions of the calyx linear, as long as the tube of the minute white corolla. Ogden Pass, Maj. Stansbury. Yoab Valley, May, Mrs. Carrington.

Gilia *pulchella*, Dougl. in Hook. fl. Bor. Am. 2, p. 74. Erect, 1—2 feet high. Stem paniculate at top; leaves pinnately cut, segments linear; calyx short, narrowly lanceolate, mucronate; corolla elongated, tube nearly one inch long, divisions of the limb ovate-acute. Ogden Pass, Maj. Stansbury; Yoab Valley, May, Mrs. Carrington.

SOLANACEÆ.

Physalis *angulata*. Linn. Gray's Man. p. 339. (Ground Cherry.) Erect and much branched, glabrous; leaves ovate or ovate-oblong, often very sharply toothed; corolla somewhat five-lobed, small; calyx with broadly triangular subulate teeth as long as the tube, becoming conical-ovate and sharply five-angled. Great Salt Lake Valley, June, Major Stansbury.

GENTIANACEÆ.

Gentiana *affinis*. Griseb. in Hook. fl. Bor. Am. 2, p. 56. (Gentian.) Stem ascending; lower leaves obovate-oblong, obtuse; upper ones lanceolate acute with scabrous margins; cymes racemiform; the lower flowers solitary, pedicellate, the upper aggregate, subsessile; calyx 5-cleft, half the length of the corolla, divisions oblong-linear, at length

dilated; corolla open, narrow, obconical, of a blue color, with oblong lanceolate-obtuse lobes 3 times longer than the cleft appendages. Great Salt Lake Valley, Major Stansbury.

ASCLEPIADACEÆ.

ACERATES *decumbens*. Decaisnes in D. C. Prodr. VIII. p. 522. *Anantherix decumbens*, Nutt. (Milk Weed, Silk Weed.)

Var. *erecta*. Stem erect, 3 feet high. Leaves scattered, sometimes verticillate in threes, ovate-lanceolate, 4—5 inches long and 1 broad, shortly petiolate. Umbel terminal solitary, globose, 2½—3 inches in breadth; pedicels pubescent; calyx and corolla green, crown deep purple. Great Salt Lake City. May. Mrs. Carrington. Probably the same that was found by Major Stansbury on Stansbury Island, and mentioned by him, at page 175 of his report, under the name of Silk-plant.

CHENOPODIACEÆ.

OBIONE *canescens*. Moq. in D. C. Prodr. XIII. p. 112. *Plerochitum occidentale*, Torr. & Frem., in Fremont's 2d Rep., p. 318. Stem suffrutescent, erect, somewhat angular; leaves sessile, alternate, oblong or linear-oblong, entire, covered with a whitish-mealy crust; flowers dioicious, glomerate on short pedicels at the summit of the branches; fruit compressed, from bracts 2 lines long. Saline soils on the border of the Lake, Maj. Stansbury and Col. Fremont.

O. . . . *confertiflora*, Torr. and Frem. Rep. Stem pubescent, much branched, erect; leaves alternate, ovate, rather obtuse, petiolate, entire, crowded, somewhat coriaceous, white with a mealy crust; bracts broadly ovate, obtuse, entire, the sides without appendages. A small shrub with rigid, crooked and somewhat spinescent branches of a whitish aspect. On the flats of the Lake with the preceding, Col. Fremont.

GRAYA *polygonoides*. Hook. and Arn. in Hook., Icon. pl. t. 281 and 388. *G. spinosa*, Dougl. in D. C. Prodr. XIII., p. 119. (Grease-wood.) Stem erect and branching; branches ascending or divaricate, terminating into a spine, and covered with a whitish bark; leaves 6—10 lines long, 1½—2 broad, oblong-lanceolate or obovate, cuneate at base, fleshy, subcoriaceous, whitish; calyx fructiferous, elliptic, emarginate at base; style persistent, shortly apiculate; fruit very small, resting on the centre of the calyx; seed orbicular-elliptic, with a somewhat obtuse margin. Saline Shores of Carrington Island. Major Stansbury.

SALICORNIA *herbacea?* (Glasswort.) Linn. Gray's Man., p. 366. Annual, erect or ascending, much branched; the joints somewhat thickened at their summit, and with two short blunt or notched teeth; spikes elongated, tapering, but rather obtuse at the apex. Southern Flats of the Great Salt Lake, Colonel Fremont.

ARTHROCNEMUM *fruticosum*. Moq. in D. C. Prodr. XIII., p. 151. Torr. in Stansb. Rep., p. 394. Stem frutescent, one foot high, and much branched; the joints of the branches

more or less compressed; spikes cylindrical, and not jointed; flowers alternate, immersed in deep excavations of the rachis; calyx quadrangular, consisting of four cohering sepals which are cuculate, spongy at the summit, and at length separate from each other; stamen solitary; seed oblong and loose in the utricle. A common plant in all the Salines of New Mexico and California, Northern Flats of the Great Salt Lake, Major Stansbury.

CHENOPODINA *linearis*. Moq. in D. C. Prodr. XIII., p. 164. (Sea Goosewort.) About three feet high, lower part of the stem stout and shrubby. Leaves long, semiterete, acute, dilated at base and subamplexicaule; flowers axillary, sessile, solitary, or 2—3 glomerate, subspicate; calyx fructiferous, but little inflated, cuculate-carinate, greenish; seed acute, with a very short beak. Western Shores of the Lake, Major Stansbury.

NYCTAGINACEÆ.

ABROMIA *mellifera*. Dougl. in Hook. Bot. Mag. t. 2879. D. C. Prodr. XIII. p. 435. Stem procumbent, ramose, succulent-glutinous, greenish; leaves fleshy, veined, long-petiolate; peduncles 4—6 inches high; involucre 5-cleft, lobes oblong-lanceolate, at length reflected; flowers not crowded; perigonium less than one inch long; tube greenish, glabrous, often incurved, with a slender base; limb 5-cleft, with undulating lobes; stamens about the length of the calyx, style shorter, fruit with 5-winged ribs. Strong's Knob, Major Stansbury.

A. . . . *fragrans*. Nutt. Hook. Kew Journ. Bot. V. p. 261. Distinguished from *A. mellifera* by its very numerous, pure white and highly fragrant flowers; tube of the perigonium filiform; involucre composed of 5—6 very large, broadly ovate, scarious-white leaflets; fruit scarcely winged. Near Sand-Hill Creek. Great Salt Lake Valley. July, Mrs. Carrington.

POLYGONACEÆ.

ERIOGONUM *ovalifolium*. Nutt. in Journ. Ac. Nat. Sc. Phil. VII. p. 50. D. C. Prodr. XIV. p. 10. Perigonia yellow, Maj. Stansbury.

Var. *purpureum*, *E. purpureum*. Nutt. Leaves all radical, petiolate, roundish-ovate, whitely tomentose; capitulum made up of several sessile whitely tomentose involucres; outer segments of the purplish perianth orbicular, sometimes emarginate at base; the inner emarginate with narrow segments scarcely exserted. Differing from E. ovalifolium, only by the purplish perigonia. On a stony mountain, on the lake, Mrs. Carrington.

E. . . . *umbellatum*, Torr. in Ann. Lyc. Nat. Hist. II. p. 241. Stem ramose from the base; leaves oval, narrowing towards the petiole, white tomentose, but at length becoming glabrous. Peduncles with 1—2 umbels; involucre villous, deeply 6—8-cleft, divisions lanceolate, reflexed, longer than the tube; perigonium glabrous, yellow. Valley of the Salt Lake, Maj. Stansbury.

E. . . . *brevicaule,* Nutt. in Jour. Ac. Nat. Sc. Ph. N. Ser. 1 p. 163. *E. Fremontii,* Torr. in Frem. Rep. Branches very short, clustered, tomentose; leaves linear-lanceolate, elongated and rather acute, attenuated into a long petiole, whitely-tomentose beneath, less so above; upper scapoid stem very smooth; bracts acuminate, tomentosely margined; umbel 2—3 times compound, with very large rays; flower small, glabrous, yellow. Valley of the Great Salt Lake, Maj. Stansbury.

SANTALACEÆ.

COMANDRA *Pallida,* D. C. Prodr. XIV. p. 636. (Bastard Toad-Flax.) Stem almost herbaceous; peduncules several, corymbosely clustered at the summit; calyx tube conspicuously continued beyond the ovary, forming a neck to the globular urn-shaped fruit; the lobes oblong; style slender; fruit dry. Stansbury Island, Major Stansbury. Salt Lake Valley, Mrs. Carrington.

URTICACEÆ.

CELTIS. . . . (Nettle Tree.) A species of celtis perhaps new? Was seen by Col. Fremont at the southern extremity of the Salt Lake.

CUPULIFERÆ.

QUERCUS. . . . (Oak.) Timber is said to grow on the Oquirrh Mountains, and on the hills of Stansbury Island, composed of oak and other trees.

SALICACEÆ.

SALIX. . . . (Willow.) Willows are common in the meadows at the foot of the mountains, and their presence is an indication of springs of running water.

POPULUS *monilifera,* Ait. Gray's Man. p. 419. *P. Canadensis,* Mich. (Cotton Wood.) Young branches slightly angled, at length becoming round. Leaves broadly deltoid, with spreading prominent nerves, slightly heart-shaped or truncate at base, taper-pointed, serrate. Fertile catkin very long; scales lacerately fringed, dilated and very large. Mouth of Weber River, Col. Fremont.

CONIFERÆ.

Pines and cypress in stunted forms are found on the tops of mountains, and even large trees on the Oquirrh Mountains, and hills of Stansbury Island.

EPHEDRA *Americana.* Willd. Torr. in Stansb. Rep. p. 395. A leafless shrub, with numerous fastigiate cylindrical-pointed branches, furnished at each joint with a sheath of two oval-acuminate and subulate leaflets. Catkins about four, one of which bears the male flower, appearing at the joints of the branches. Fruit an oval two-seeded berry, formed from the scale of the calyx becoming fleshy after flowering; seed oval-acute, convex on one side, flat on the other. Shores of the Salt Lake, Maj. Stansbury.

JUNCAGINEÆ.

TRIGLOCHIN *maritimum*. Linn. Gray's Man. p. 437. (Arrow Grass.) A plant with thickish fleshy leaves, rush-like, sheathing the base of the jointed scape; flowers small, in a spiked raceme; fruit ovate or oblong, acutish, of 5—6 carpels, rounded at the base and slightly grooved at the back, the edges acute. Saline shores of Stansbury Island. June. Major Stansbury.

LILIACEÆ.

POLYGONATUM *giganteum*. Dietrich. Gray's Man. p. 446. *P. canaliculatum*, Pursh. (Great Solomon Seal.) Glabrous throughout; stem stout and tall, terete; leaves ovate, partly clasping; the upper oblong and nearly sessile, many nerved, green on both sides. Peduncles 2—8 flowered, perianth cylindrical, oblong; filaments smooth, inserted on the middle of the tube. Valley of the Great Salt Lake. Major Stansbury.

ALLIUM *stellatum*. Fraser, in Hook., fl. Bor. Am. 2, p. 184, t. 144. (Garlic.) Bulb oblong-ovate; leaves flat, linear lanceolate, shorter than the scape; scape elongated, terete; umbel erect, multiflore, loosely fastigiate; sepals oblong, acute, not longer than the stamens, of a bright red colour; ovary 3—lobed, with a double wing-like crest at top. Mouth of Weber River. May. Major Stansbury.

A. . . . . *reticulatum*. Fraser, in Hook., fl., Bor. Am. 2, p. 184, t. 145. Bulb oblong with a densely matted fibrous coat; leaves flat, linear-lanceolate, shorter than the scape; umbel erect, densely fastigiately flowered; sepals narrowly ovate, acuminate, longer than the stamens; ovary shortly 6—fid at the apex; remarkable for its white glossy flowers. Wasatch Mountains. June. Major Stansbury.

AMBLIRION *pudicum*. Torr. *Lilium pudicum*. Pursh. fl. 1. p. 228, f. 1. *Fritillaria pudica*, Spreng.

Var. *biflorum*. Torr. in Stansb. Rep., p. 396, t. IX. Root flat, orbicular and toothed round the border, with a cluster of little tubers on the upper side at the base of the two-flowered stem; leaves linear, 2—4 inches long; flowers yellow, nodding, about an inch in length, somewhat obconical or funnel form, entirely destitute of a nectariferous grove; stigma simple, undivided. Promontory Range. April. Major Stansbury.

CALOCHORTUS *Nuttallii*. Torr. in Beckwith's Rep., p. 124. *C. luteus*, Nutt. in Jour. Acad. Nat. Sc. Ph., n. s. VII. p. 19. Stem 2—4 flowered, (one specimen with 4 flowers;) leaves narrowly linear, with a long subulate acumination; radical leaves 8 inches long. Flower more than 3 inches in diameter; exterior sepals lanceolate, acute, greenish along the centre, with a scarious margin and a small purple spot towards the base, two-third the length of the inner sepals, which are dilated, wedge-shaped and shortly pointed in the centre; lamina white with an oblong-oval purple spot toward the base, in the centre

of which is an oval densely tomentose brownish tuft; claw yellow. Stamens short; capsule linear-oblong, 3—sided; 3 short and reflexed stigmas. Great Salt Lake Valley. Mrs. Carrington. This description is made upon the beautiful specimens collected by this lady. I doubt not that my plant is the same as that mentioned by Professor Torrey in Stansbury's report and the same as Mr. Nuttall's plant, who, for want of a good specimen, mistook the colour of the corolla. The root is called by the natives *sego*, and is much esteemed by them as food.

Erythronium *grandiflorum*. Pursh. fl. 1, p. 231. (Dog's Tooth.) Leaves oblong-lanceolate, obtuse; divisions of the calyx ovate-lanceolate-acuminate, reflexed from the very base; stigma 3-cleft, the segments recurved; flowers yellow, white at the base. Valley of the Salt Lake. Maj. Stansbury.

Yucca. . . . (Bear-Grass.) Specimens with leaves only, 6—8 inches long, narrow, carinate, with an elongated spine; margin entire, white, sparingly furnished with fine white threads, scarcely curled. Mrs. Carrington.

Brodiea *grandiflora*. Smith. Linn. trans. *Tritelleia grandiflora*. Torr. Stansb. Rep.

Var. *Brachypoda*. Torr. Whippl. Rep. p. 149. Umbel multiflore, pedicels much shorter than the flowers; sterile stamens broadly lanceolate, entire. May. Great Salt Lake Valley. Major Stansbury and Mrs. Carrington.

B. . . . . *parviflora*. Torr. Whippl. Rep. p. 125. Umbel about an inch and a half in diameter; pedicels unequal, many of them scarcely half the length of the pale purple flower, the tube of which is somewhat inflated. Fertile stamens 3, inserted on the upper part of the tube, opposite the inner segments; anthers linear-oblong, acute at each end. Style filiform; stigma dilated, 3—lobed, the lobes fimbrillate-papillose. On Prevost's Fork of Utah, and perhaps also in the Salt Lake Valley. Col. Fremont.

MELANTHACEÆ.

Anticlea *Nuttallii*. Gray. Melanth. revised, in Ann. Lyc. New York, IV. p. 123. *Amianthium Nuttallii*. Gray. *Amientanthus Nuttallii*. Kunth. (The poison or death camass of the Indians.) Stem 18 inches high, terete, slightly sulcate towards the base; inferior leaves 6—12 inches long, carinate, acute, the middle ones shorter, attenuate; the uppermost bractiform; racemes simple, or sometimes compound; pedicels filiform with scarious filiform bracts; flowers white, sepals a little longer than the stamens, broad oval or subovate, with the alternate ones narrower, obtuse, subcordate or round, abruptly unguiculate. Valley of the Salt Lake. May. Maj. Stansbury. At the foot of the Oquirrh Mountains. Lieut. Beckwith.

JUNCACEÆ.

Juncus *Balticus*. Willd. Gray's Man., p. 180. (Bog Rush.) Scape rigid, 2—4 feet

high, from a very strong rootstock. Panicle ascending, loose, dark chestnut colour; sepals ovate-lanceolate, the three outer sharply pointed, as long as the elliptic and rather 3—angular pod. Antelope Island. June. Major Stansbury.

COMMELYNACEÆ.

TRADESCANTIA *Virginica.* Linn. Gray's Man. p. 486. (Spider Wort.) Plant either smooth or hairy. Leaves linear-lanceolate, elongated, tapering from the sheathing base to the point, ciliate, more or less open; umbels terminal, many flowered, filaments of the stamens bearded, flowers blue, or white. On the right bank of the Elk-Horn. July. Mrs. Carrington. Her unique specimen has very narrow leaves with an umbel of a few flowers.

CYPERACEÆ.

SCIRPUS *Torreyi.* Olney. Gray's Man. p. 499. Culm 3—angled with concave sides, rather slender, 2 feet high, leafy at the base; leaves 2—3, more than half the length of the culm, triangular, channelled, slender. Spike 1—4, ovate-oblong, acute, sessile, long, overtopped by the slender, erect involucral leaf; scales ovate, smooth, entire, barely mucronate. Prof. Torrey, in Stansb. Rep., says that the specimen of Major Stansbury differs merely from the above in its longer and larger spikes and in the shorter point of the achenium. Stansbury Island. June. Major Stansbury.

GRAMINEÆ.

ERIOCOMA *cuspidata.* Nutt. Gen. 1, p. 40. *Stipa membranacea,* Pursh. *Urachne lanata.* Trin. A beautiful grass. Culm 1—3 feet high, simple; panicle spreading, dichotomous; flowers by pairs; peduncles capillary, flexuous; leaves very long, filiform, convolute, 1—foot or more long; vagina about 6 inches, entirely sheathing the stem and the panicle before evolution; ligules entire, conspicuous; calyx bivalved, 1 flowered; corolla 2—valved, short in fruit, almost spherical; seed nearly spherical. Antelope Island. June. Major Stansbury.

ARUNDINARIA. . . (Cane.) Seen by Col. Fremont at the southern end of the Lake.

UNIOLA. . . . A species of *Uniola* (Spike Grass,) was also seen by Col. Fremont with the above.

TRITICUM *repens.* Linn. *Agropyrum repens.* Gœrtn. Gray's Man., p. 569. (Quick Grass.) Rootstocks creeping extensively; spikelets 4—8 flowered; glume 5—7 nerved; rachis glabrous, but rough on the angles; awn none or not more than half the length of the flowers; leaves flat, roughish or hairy above. Antelope Island. June. Major Stansbury.

HORDEUM *jubatum.* Linn. Gray's Man. p. 570. (Squirrel-tail Grass.) A low grass.

Lateral flowers abortive, neutral, on short pedicels, short-awned; the perfect flower, bearing an extremly long awn (2 inches long,) about the length of the similar capillary glumes —all spreading. Antelope Island. June. Major Stansbury.

ELYMUS *striatus*. Willd. Gray's Man. p. 571. (Wild-Rye.) Spike dense but slender, upright or slightly nodding, 3—4 inches long, spikelets mostly in pairs, minutely bristly-hairy; glume linear awl-shaped or truly awl-shaped; bristle-awn about three times the length of the flower, not counting their capillary awn which is 1 inch long. Leaves rather narrow and sheaths smooth, or hairy, or downy. Antelope Island. June. Major Stansbury.

BUNCH-GRASS, mentioned by Maj. Stansbury, &c.*

EQUISETACEÆ.

EQUISETUM *hyemale*. Linn. Gray's Man. p. 587. (Scouring Rush.) Some Horsetails, probably the above, are mentioned by Major Stansbury and Col. Fremont as common in the meadows at the foot of the mountains and, generally, in marshy grounds.

* Mr. George Thurber, an able botanist who has visited the Western regions, informs me that prairie men call all very good grass on high land *Grama*, and any rather coarse grass, growing in tufts, *Bunch Grass*, without regard to genera or species. The Bunch Grass of Oregon is *Elymus condensatus*, Presl. He has had also *Bouteloua curtipendula* from the far West under this name. Of the grasses mentioned in Stansbury's report by Prof. Torrey, *Triticum repens* and *Elymus Striatus* are the only ones sufficiently branchy in habit to merit the name of Bunch-Grass.

ARTICLE XV.

OBSERVATIONS OF THE MAGNETIC DIP IN THE UNITED STATES.

BY PROF. ELIAS LOOMIS.

In the Transactions of the American Philosophical Society, Vol. VII., pages 1—6, and pages 101—111; also, Vol. VIII., pages 65—72, and pages 285—304, I have given numerous observations on the Dips of the Magnetic Needle, made by myself, in different parts of the United States. The following observations were made with the same instrument heretofore employed. This instrument was made by Gambey, of Paris, and has two needles. In 1841, the axis of one of the needles appears to have sustained some injury, and since that time the needle has been entirely discarded, and all the observations have been made with the other needle. The mode of observation is the same as has been described in Vol. VII., page 3, of the Transactions of the American Philosophical Society.

Magnetic Dips at Hudson, Ohio, Lat. 41° 15′, Long. 81° 25′ West.

Place of observation, magnetic station formerly used.

Date.	Hour.	Polarity.	No. Readings.	Dips.
1842, May 17.	9—10 A. M.	Mark down.	40	72° 45.′2.
" "	"	Mark up.	40	53.3.
" "	"	Mean result.	80	49.3.
" "	10—11 A. M.	Mark up.	40	53.0.
" "	"	Mark down.	40	47.8.
" "	"	Mean result.	80	50.4.
		Mean of both sets of obser.	160	72 49.9.
1842, Aug. 23.	9—10 A. M.	Mark down.	40	72 46.7.
" "	"	Mark up.	40	51.4.
" "	"	Mean result.	80	49.1.

Date.	Hour.	Polarity.	No. Readings.		Dip.
1842, Aug. 30.	10—11 A. M.	Mark down.	40	72	46.9.
" "	"	Mark up.	40		46.9.
" "	"	Mean result.	80		46.9.
1842, Sep. 14.	3—6 P. M.	Mark down.	40		41.6.
" "	"	Mark up.	40		46.5.
" "	"	Mean result.	80		44.0.
		Mean of three sets of obser.	240	72	46.7.
1843, June 26.	2—5 P. M.	Mark up.	40	72	46.0.
" "	"	Mark down.	40		48.4.
" "	"	Mean result.	80		47.2.
1843, Sep. 18.	7½—9½ A. M.	Mark down.	40	72	45.1.
" "	"	Mark up.	40		50.3.
" "	"	Mean result.	80		47.7.
1844, June 22.	7—8 A. M.	Mark up.	40	72	47.6.
" "	"	Mark down.	40		51.8.
" "	"	Mean result.	80		49.7.
1849, July 18.	3—5 P. M.	Mark down.	40	72	55.5.
" "	"	Mark up.	40		53.3.
" "	"	Mean result.	80		55.4.
1849, July 27.	7—9 A. M.	Mark up.	40	72	54.7.
" "	"	Mark down.	40		56.2.
" "	"	Mean result.	80		55.5.
1849, July 27.	9—11 A. M.	Mark down.	40		55.5.
" "	"	Mark up.	40		54.8.
" "	"	Mean result.	80		55.2.
		Mean of obser. in 1849.	260	72	55.4.
1859, April 2.	10½—12 A. M.	Mark up.	40	72	65.6.
" "	"	Mark down.	40		58.9.
" "	"	Mean result.	80	73	2.3.

The following Table presents a summary of all the observations made at Hudson, Ohio, the numbers here given indicating the mean of all the observations of the year:—

Date.	Dips.
1838—68.	72° 48.2′.
1839—46.	47.6.
1840—35.	49.5.
1841—60.	48.1.
1842—52.	48.3.
1843—59.	47.5.
1844—47.	49.7.
1849—56.	55.4.
1859—25.	62.3.

These observations indicate, that at Hudson, Ohio, the Dips of the Magnetic Needle remained sensibly stationary from 1838 to 1844; and, that since the latter date, the Dip has slightly increased.

In order to determine whether the instrument had sustained any injury, I requested Prof. C. A. Young, of Western Reserve College, to make a series of observations similar to those which I have published in the Transactions of the American Philosophical Society, Vol. VIII., page 66. This he accordingly did, and the following are his results. The observations were made from April 19th to May 2d, 1859, and each number in the two columns headed "Poles Direct," "Poles Round," is the mean of twenty readings, making a total of 1360 readings, besides a double set of readings for azimuths and 180 degrees.

Magnetic Dips observed at Hudson, Ohio, by Prof. C. A. Young.

Azimuth.	Poles Direct.		Poles Round.		Mean.		Dips Deduced.	
	°	′	°	′	°	′	°	′
0	72	59.4	72	52.0	73	2.1	73	2.1
180	73	11.3	73	5.8				
10	73	16.0	73	1.6	73	15.0	72	59.7
190	73	22.8	73	19.5				
100	87	7.5	86	57.4	86	53.6		
280	86	41.5	86	47.9				
20	74	6.7	78	38.5	73	59.9	73	6.0
200	74	10.5	74	3.8				
110	84	25.4	84	28.9	84	16.2		
290	84	7.7	84	2.7				
30	75	19.5	74	38.0	75	7.8	72	57.7
210	75	17.7	75	15.9				
120	81	35.7	81	38.1	81	18.0		
300	81	1.3	80	56.6				
40	76	46.5	76	36.7	76	44.3	72	45.5
220	76	38.5	76	55.3				
130	78	42.9	78	55.5	78	35.2		
310	78	7.9	78	34.3				

Azimuth.	Poles. Direct.		Poles Round.		Mean.		Dips Deduced.	
	°	′	°	′	°	′	°	′
50	77	59.5	78	33.7	78	33.3	72	45.7
230	78	41.1	78	58.6				
140	76	39.5	76	57.6	76	46.2		
320	76	48.3	76	39.2				
60	80	50.3	81	1.1	81	13.9	72	52.0
240	81	29.2	81	35.0				
150	75	13.8	75	17.6	75	3.3		
330	75	3.7	74	38.1				
70	84	3.5	84	1.0	84	12.3	73	4·0
250	84	15.0	84	29.9				
160	74	6.5	74	4.3	73	59.1		
340	74	8.4	73	37.1				
80	86	33.6	86	44.2	86	52.3	73	1.1
260	87	21.1	86	59.4				
170	73	31.9	73	18.6	73	16.6		
350	73	12.5	73	3.1				
General Mean.							72	57′1

As these observations did not agree as well as was expected, a second series of observations was undertaken. The whole number of readings in the second series was 2880, (being ten of each end of the needle in every position,) besides some 500 or 600 more in the re-examination of all readings that seemed either too discordant with the former results or suspicious in themselves. The observations were all taken between the hours 7½ and 10 A. M., and the readings for the azimuth 60, 70 and 80 degrees, were all made between the hours 8½ and 9½ A. M.

The following is the summary of the second series of observations made between May 4th and June 30th, 1859.

Magnetic Dips observed at Hudson, Ohio, by Prof. C. A. Young.

Observations Repeated.

Azimuth.	Poles direct.	Poles round.	Mean.	Dip deduced.	Azimuth.	Poles direct.	Poles round.	Mean.	Dip deduced.
	° ′	° ′	° ′	° ′		° ′	° ′	° ′	° ′
0	73 1.9	72 52.4	73 2.7	73 2.7	50	77 59.8	78 36.5	78 33.4	72 45.8
180	73 10.4	73 6.2			230	78 39.3	78 58.2		
10	73 14.9	73 5.5	73 16.5	73 1.3	140	76 42.0	76 56.0	76 46.2	
190	73 25.5	73 20.2			320	76 51.4	76 35.2		
100	87 7.2	87 0.7	86 54.1		60	80 55.2	81 3.3	81 16.4	72 58.1
280	86 43.0	86 45.6			240	81 31.4	81 35.7		
20	74 10.1	73 39.7	74 1.3	73 7.7	150	75 19.3	75 17.2	75 9.1	
200	74 14.0	74 1.5			330	75 23.4	74 36.5		
110	84 25.6	84 30.0	84 17.3		70	84 7.2	84 0.3	84 13.8	73 6.5
290	84 8.8	84 4.8			250	84 20.9	84 26.6		
30	75 22.7	74 33.5	75 5.5	72 56.9	160	74 13.6	74 2.7	74 1.3	
210	75 13.8	75 11.8			340	74 8.5	73 40.1		
120	81 35.6	81 40.5	81 20.5		80	86 42.0	86 44.0	86 52.7	73 0.6
300	81 0.8	81 5.2			260	87 8.6	86 59.2		
40	76 52.4	76 35.2	76 45.5	72 47.5	170	73 27.2	73 17.9	73 16.1	
220	76 40.5	76 54.1			350	73 13.5	73 5.8		
130	78 40.8	79 0.2	78 36.9						
310	78 7.5	78 36.9							
							General mean.		72° 58′.6

These observations agree very well with the first series, but the results harmonize very little better with each other. If we deduct the Dip by the formula cot δ = cot I sec a, we shall obtain the following results:

	First Series.		Second Series.	
Azimuth.	Inclination.	Dip.	Inclination.	Dip.
	° ′	° ′	° ′	° ′
0	73 2.1	73 2.1	73 2.7	73 2.7
10	73 15.8	73 1.2	73 16.3	73 1.7
20	73 59.5	73 1.3	74 1.3	73 3.2
30	75 5.6	72 54.8	75 7.3	72 56.7
40	76 45.2	72 55.1	76 45.9	72 55.9
50	78 34.2	72 32.4	78 35.1	72 33.7
60	81 15.9	72 55.4	81 18.5	72 59.9
70	84 14.2	73 33.7	84 15.5	73 37.1
80	86 52.9	72 34.8	86 53.6	72 37.7
Mean Dip.		72 56.7	Mean Dip.	72 58.8

From the preceding results, it is pretty evident that the instrument with which the observations were made, has sustained some injury since 1844, and this injury is probably in the axis of the needle. The axis is apparently free from rust, and no imperfection can be detected by ordinary inspection, but a very slight flexure of the axis, or the smallest want of cylindricity, would produce discrepancies such as are here exhibited. I think,

however, that these observations are sufficient to furnish the Dip with an uncertainty not exceeding five minutes. If we take a mean of all the observations without distinction, we obtain for a result 72° 57′.8. If we reject the readings which differ most from the mean, we obtain for a result 72° 58′.6. The latter result is, I think, to be preferred; but either result indicates that the Dip of the needle at Hudson has increased since 1844.

The following are a few additional observations made by myself in the vicinity of Hudson:

Tallmadge, Lat. 41° 7′, Long. 81° 25′ West, near the coal mine.

Date.	Hour.	Polarity.	No. Readings.	Dip.
1842, Sept. 3.	11—12 M.	Mark up.	40	72° 54.′0
" "	"	Mark down.	40	51.1
" "	"	Mean result.	80	5.25

North Akron, Lat. 41° 5′, Long. 81° 30′ West, a quarter of a mile east of the village.

1842, Sept. 5.	2—3 P. M.	Mark down.	40	72 48.1
" "	"	Mark up.	40	56.4
" "	"	Mean result.	80	52.2

Cuyahoga Falls, Lat. 41° 9′, Long. 81° 27′ West, a quarter of a mile south-east of the village.

1842, Sept. 6,	10—11 A. M.	Mark up.	40	72 52.1
" "	"	Mark down.	40	49.6
" "	"	Mean result.	80	50.9
" "	11—12 M.	Mark down.	40	50.3
" "	"	Mark up.	40	54.5
" "	"	Mean result.	80	52.4
" "	Mean of both series of observations.		160	72 51.6

Franklin, Lat. 41° 11′, Long. 81° 20′ West.

1842, Sept. 8,	4—5 P. M.	Mark up.	40	72 55.4
" "	"	Mark down.	40	51.2
" "	"	Mean result.	80	53.3

Rootstown, Lat. 41° 7′, Long. 81° 14′ West.

1842, Sept. 9,	1—2 P. M.	Mark down.	40	72 51.3
" "	"	Mark up.	40	68.2
" "	"	Mean result.	80	59.7

Paris, Lat. 41° 11′, Long. 81° 2′ West, near the village.

Date.	Hour.	Polarity.	No. Readings.	Dip.
1842, Sept. 10,	6—7 A. M.	Mark up.	40	73 11.0
" "	"	Mark down.	40	72 54.0
" "	"	Mean result.	80	73 2.5

The following observations were made by myself with an instrument kindly loaned for this purpose by Prof. Bache, Superintendent of the United States Coast Survey. The place of observation was in the middle of the grove behind the Lunatic Asylum at Bloomingdale, about seven miles north of the City Hall of New York.

Bloomingdale, Lat. 40° 49′, Long. 73° 57′ West.

1859, June 11,	10½ A. M.—3 P. M.	Needle No. 1.	40	72 45.5
" "	"	Do. poles round.	40	60.2
" "	"	Mean of No. 1.	80	52.9
" "	"	Needle No. 2.	40	44.8
" "	"	Do. poles round.	40	56.5
" "	"	Mean of No. 2.	80	50.7
" "	"	Needle No. 3.	40	36.3
" "	"	Do. poles round.	40	59.5
" "	"	Mean of No. 3.	80	47.9
" "	"	Mean of three needles.	240	72 50.5

These observations, compared with those heretofore made in this vicinity, indicate that the Dip of the needle at New York was decreasing from 1823 to 1846, since which time it has slightly increased. These results correspond tolerably well with those obtained at Hudson, Ohio, both as respects the time and amount of the change of Dip.

ARTICLE XVI.

Revision of the Buprestidæ of the United States. By John L. Le Conte, M.D. Read October 21st, 1859.

THE family of Coleopterous insects treated of in the present memoir has ever been a favourite with Entomologists on account of the large size and splendid colours of many of the species which compose it. Nevertheless the imperfect manner in which it has been studied, and the very superficial observations regarding the generic differences and relations, entirely precluded the possibility of any American entomologist producing a systematic work on this family. Happily, the appearance of the fourth volume of the great work of Lacordaire on the genera of Coleoptera, in which this family is treated of, has entirely removed this difficulty, and I now find myself able to present descriptions of the numerous new species which have been accumulating in my collection.

The author of the work just mentioned, having been able to study species of all the genera so crudely described by previous authors, has been enabled to eliminate the errors of observation and the imperfections resulting from the vague ideas of those who had previously attempted a classification of this family.

In studying the species found within our territories, I have found but little to change from the arrangement proposed by Lacordaire, who has, apparently, grouped the genera in a natural manner, and with the usual happy results that attend his labours. The main difference, I have introduced, is one, perhaps, inevitable from the fact that the material subjected to examination has been different; his observations extend over the species of the entire globe, while mine are confined to those of a portion of one continent. Without at all contending for the superior merit of any change introduced by me, I will only say, that the division of the entire family into groups of equal value has appeared to me the most satisfactory in arranging the material in my possession.

I should gladly have attributed to the antennal pores observed in the species of this family, the primary importance given them in the work of my learned friend, but that I

have observed in every great group, some exceptions to the form presented by the majority of the species of the same group: this appears to me an objection to combining the groups, perfectly natural in themselves, into larger series which are defined by the position of these antennal pores; and this is the only point in which I have diverged from the arrangement of Lacordaire.

The characters of the family have been already exposed by me in my revision of the Elateridæ of the United States, but may be briefly recapitulated as follows:

Coxæ anticæ parvæ, globosæ, non contiguæ, in acetabulis e prosterno et mesosterno compositis receptæ: prosternum pone coxas productum in mesosterno vel etiam in metasterno receptum; abdomen sutura ventrali anteriore plus minus obliterata, segmentis 1 et 2 connatis: tarsi 5 articulati, articulis 1–4 vel 3–4 subtus lobis membraneis instructis: antennæ serratæ, articulis externis præcipue poriferis: oculi integri, elliptici.

The character deduced from the consolidation of the two anterior segments of the abdomen has been called in question by Kiesenwetter, Ins. Deutschl. iii. 6, and 50, (but his observations seem to be defective, (vide infra Ancylochira;) and although the suture between these two segments is frequently visible, it never permits of any movement like the other ventral sutures.

In some genera the species approximate so clearly as to present the phenomena of races: instances will be seen in Chrysobothris, Agrilus, and perhaps in Dicerca and Chalcophora.

The groups of genera, as defined in the following paper may be thus tabulated:

* Front not contracted by the insertion of the antennæ.

A. Prosternum obtusely or scarcely angulated on the sides, tip obtuse, (except in Cinyra,) mesosternum divided.

I. Mesosternum closely anchylosed with metasternum; antennal pores lateral. Gyascutus, Chalcophora, Psiloptera.

II. Mesosternal suture distinct; antennal pores marginal. Dicerca, Pœcilonota, Ancylochira, Cinyra.

III. B. Prosternum acutely angulated on the sides, acute at tip; mesosternum divided. Melanophila, Anthaxia.

IV. C. Prosternum short, broad, obtuse, not angulated on the sides; mesosternum rarely divided. Thrincopyge, Chrysophana, Polycesta, Ptosima, Acmæodera.

* * Front contracted at the insertion of the antennæ.

V. Prosternum acutely angulated at the sides, acute at apex; mesosternum narrowly divided; mentum corneous at base, membranous at tip. Chrysobothris, Actenodes.

VI. Prosternum cuneate, not angulated on the sides; mentum large corneous, front perpendicular, mouth inferior, applied to the prosternum. Coræbus, Agrilus.

VII. Prosternum not angulated at the sides, apex cuneate, fissured, or truncate: mesosternum very widely divided; front inflexed, mouth inferior, applied to prosternum; mentum large corneous; legs contractile, tarsi very short. Brachys.

VIII. Prosternum broad, truncate, front perpendicular, mouth inferior free, mentum large corneous; legs not contractile. Haplostethus.

GROUP I.

This group is distinguished by the prosternum being obtusely angulated on the sides behind the coxæ, and then obtusely acuminate: the mentum is entirely corneous: the front is not lobed, the antennal cavities are variable in size: the antennæ have the pores diffused on the lower portion of the sides, but varying greatly in the space they occupy. The mesosternum is closely connate with the metasternum, and is broadly divided. The scutellum is small and rounded, sometimes not conspicuous: the tarsi are lobed beneath, and the first joint is elongated in two of our genera, and short in the third.

Antennæ sub carina majuscula insertæ; mentum late rotundatum	- -	Gyascutus.
Antennæ in foveis parvis insertæ; mentum late emarginatum	- -	Chalcophora.
Antennæ in foveis majusculis insertæ; mentum late rotundatum	- -	Psiloptera.

GYASCUTUS *Lec.*

Antennæ distantes sub carina obliqua elevata insertæ, articulo 1mo conico paulo crassiore, 2 et 3 cylindricis, 4to triangulari 3io haud breviore, margine inferiore poroso, 5—10 sensim paulo brevioribus, infra medium porosis; 11mo apice lobato. Fossulæ antennales magnæ profundæ. Labrum emarginatum. Mandibulæ valde obtusæ; palpi maxillares haud dilatati. Mentum breve corneum antice late rotundatum. Prosternum lateribus postice angulatum, medio obtusum; mesosternum metasterno integro connatum, sutura obliqua, late divisum. Pedes graciles, tarsi subtus lobati, postici plerisque compressi articulo 1mo elongato.

This genus seems most related to Pelecopselaphus, which it resembles in form as well as in the narrow compressed posterior tarsi of some of the species: but it differs from that as from every other genus I have seen, by the elevated ridges above the antennæ.

The tip of the abdomen in both sexes has a transverse elevated line near the margin, which in the female is less distinct than in the male: in the latter the line is acute, and forms an acute tooth each side, thus causing the posterior outline to be distinctly sinuous, while in the female it is broadly subtruncate: the inferior anal plate is in the male prolonged in the middle, forming an acute process, which, however, is usually concealed from view. The sides of the elytra are feebly serrate behind the middle. Our species form two groups; the antennal pores in the second are more numerous, covering nearly the whole of the sides of the articulations, and the basal joint of the posterior tarsi is less elongated, and less compressed.

a. *Epistoma late emarginatum: tarsi postici articulo 1mo sequentibus duobus æquali.*

1. G. planicosta. *Chalcophora planicosta* Lec. Proceedings Acad. Nat. Sc., 1858, 66. Tab. XII. fig. 1.
2. G. obliteratus. *Chalcophora obliterata* Lec. ibid.

These two species were collected by Dr. Thos. H. Webb, on a journey from El Paso to

San Diego. The second was found abundantly by Capt. Pope in exploring the Llano Estacado.

b. *Tarsi postici articulo 1mo sequente parum longiore.*

* *Epistoma late emarginatum.*

3. G. caelatus. *Chalcophora cælata* Lec. Proc. Acad., 1858, 67. Ures, Sonora, Dr. Webb.

* * *Epistoma profunde emarginatum.*

4. G. sphenicus. *Buprestis sphenica* Lec. Proc. Acad., 7, 83. Texas, Mr. Schott.

Chalcophora Sol. (emend. Lac.)

Our species fall into two groups, according as the margin of the elytra is entire, or strongly serrate: in the first, the antennal pores are not numerous; in the second, they occupy the sides of the 5th and following joints below the middle, as in the preceding genus. The males have the 5th abdominal segment deeply marginate, with a distinct, entire anal segment.

a. *Elytra margine integro vel subtiliter serrato: thorax inæqualis costa dorsali distincta.*

* Elytris plagis dilatatis nitidis, sulco subsuturali interrupto.

Thorax lateribus antice valde angulatis (ænea) - - - -	angulicollis.
Thorax lateribus subangulatis (nigro-ænea) - - - - -	lacustris.
Thorax lateribus antice late rotundatis (nigro-ænea) - - - -	virginiensis.

* * Elytris plagis minus dilatatis, sulco subsuturali integro.

Thorax lateribus antice late rotundatis.	
Sulcis mediis parum profundis (aureo ænea) - - - -	georgiana.
Sulcis mediis profundis (cupro-ænea) - - - -	liberta.
Thorax lateribus ante medium angulatis (ænea) - - - -	fortis.

1. C. angulicollis. *Buprestis angulicollis* Lec. Pac. R. R. Report on the 47th Par. Insects, 44. *Chalcophora Oregonensis* Fitch, Trans. N. Y., State Agric. Soc., 1857, 702.

My specimen was found at Sacramento, by Mr. Wittick; Dr. Fitch's came from the Dalles of Columbia river. My description having been published in June 1857, has precedence over Dr. Fitch's, which dates from the beginning of 1858.

2. C. lacustris, supra nigro-ænea, thorace inæquali, spatiis elevatis nitidis parce, depressis opacis dense punctatis, latitudine breviore, lateribus postice parallelis, ante medium subito oblique convergentibus, inde obtuse angulatis, linea dorsali angusta, sulcis latis minus profundis, elytris spatiis depressis dense punctatis et rugosis, sulco subsuturali antice late interrupta, costa 2nda bis dilatata et subinterrupta, 3ia postice dilatata, 1ma pone impressionem posticam transversim impressa, sutura acuminata; subtus cupreo-ænea. Long. ·90—·10.

Lake Superior, one pair. This species is alluded to by me in the Pacific R. R. Report, above quoted, as a variety of C. virginiensis, but on comparison I find, independ-

ently of the form of the thorax, which is shorter, and angulated on the sides, that the sculpture of the depressed portions of the elytra is more rough, and more strongly punctured.

3. C. virginiensis. *Buprestis virginiensis* Drury, Ins. 1, 66, tab. 30, f. 3. Herbst, Käfer, 9, 114, tab. 148, f. 1: Turton's Linné, 411. ? Gory and Laporte, 2, 11, tab. 2, f. 7.

B. virginica Say, Trans. Am. Phil. Soc., 6, 157.

B. (*Chalcophora*) *virginica* Harris, Ins. Inj. to Vegetation, 44; 2nd Ed. 42; New Engl. Farmer, 1829, p. 2.

Buprestis mariana Linn. Mus. Ulr., 89.

Chalcophora liberta (var. *obscura*) Fitch, Trans. N. Y., State Agric. Soc., 1859, 701.

Chalcophora novæboracensis Fitch, ibid.

Middle, Eastern and Southern States; abundant. This species may be readily distinguished by the dull colour, the fine punctuation of the depressed spaces of the elytra, of which the four impressed spaces are better defined than in the other, and finally by the sides of the thorax being broadly rounded before the middle, and not at all angulated. The synonyms of Dr. Fitch are known to me through specimens kindly communicated to me for comparison by Mr. T. B. Ashton.

4. C. georgiana, aureo-ænea, thorace inæquali, spatiis elevatis nitidis lævibus, depressis rude punctatis, linea dorsali latiuscula, sulcis dorsalibus parum profundis postice fere obsoletis, latitudine vix breviore, lateribus antice late rotundatis; elytris sulco subsuturali integro, costa 3ia bis subinterrupta, et paulo dilatata, postice cum 1ma juncta, 3ia postice paulo dilatata cum 4ta haud confluente, spatiis depressis dense rugose punctatis, sutura acuminata. Long. ·93—1·03.

Buprestis georgiana Lec. Proc. Acad. Nat. Sc., 1857, 7.

Buprestis liberta ‡ Lap. and Gory, Mon. Bupr. 2, 11, tab. 2, f. 6.

Georgia and South Carolina. Larger and comparatively narrower than C. liberta, of a more golden colour, less rough, and readily known by the shallow grooves adjacent to the dorsal costa of the thorax.

5. C. liberta Fitch, Trans. N. Y. State Agric. Soc., 1857, 700.

Buprestis liberta Germ. Ins. Nov. 38.

Buprestis borealis Lap. and Gory, 2, 13; tab. 3, fig. 9.

Middle and Western States, abundant, varies slightly in colour, but usually of a fine golden copper tint. The broadly rounded sides of the thorax, the deep dorsal grooves, and the entire sutural stria well distinguish this species.

6. C. fortis, ænea, thorace inæquali spatiis elevatis nitidis lævibus obscurioribus, depressis rude confertim punctatis, sulcis dorsalibus modice profundis, latitudine vix breviore, lateribus ante medium obtuse angulatis; elytris sulco subsuturali integro, costa 2nda bisinterrupta, parte secunda paulo latiore, 3ia postice parum dilatata, spatiis depressis dense rugose punctatis, sutura haud acuminata. Long. 1·04.

Pennsylvania and New York, not common; sufficiently distinguished by the greater roughness of the depressed portions, and the angulated sides of the thorax.

The figure of C. virginiensis given by Laporte and Gory, and cited above, represents very well this species, which is also considered by Dr. Fitch as being Drury's: Herbst's description makes mention of the fine sculpture of the elytral impressions, and of the acuminate suture, characters not found in the one now under consideration, and which together with the obscure colour, fix the above mentioned No. 3, as the one described by him.

b. *Elytra margine pone medium fortiter serrato: thorax canaliculatus.*

6. C. campestris. *Buprestis campestris* Say, Journ. Acad., 3, 165, Am. Ent. tab. 26.
Buprestis substrigosa Lap. and Gory, 2, 13, tab. 3, fig. 10.

Middle States and Western States rare: found according to Say on the Arkansas river. This species agrees very well with Say's description, but very badly with the figure, which represents a smaller insect, with more distinct elytral costæ and no impressions, though the latter are mentioned in the text.

7. C. Langeri Chevrolat, Révue and Mag. Zool., 1854, tab. 6, fig. 1.

Louisiana, near New Orleans. Though evidently very nearly related to the preceding, I am induced to place this as distinct, on the authority of Mr. Chevrolat, who, having compared them, has kindly sent me the following notes:

"The species which I refer to C. campestris (*prionoptera* Dej.) is smaller, narrower, parallel, obscure above, dull metallic beneath, slightly pubescent, and with the punctures shallow and confluent: the elytra have four straight nervures, and three median depressions: the groove of the thorax is deeper, strongly channeled, and on each side margined. In C. Langeri this channel is visible for only three-fourths the length, and presents a slight flattened elevation near the anterior margin: moreover, the thorax is nearly triangular, and the elytra are more dilated."

A specimen from Texas in the collection of Mr. H. Ulke, which I refer to this species is 1·3 unc. long; the thorax is angulated on the sides just before the middle, then narrowed to the apex; the dorsal channel is shallow, and has a smooth medial line. In other respects it agrees with C. campestris.

Psiloptera Sol. (emend. Lac.)

Our species have the appearance somewhat of gigantic Dicercæ, and are nearly related to the Mexican Buprestis Drummondi, Lap. & Gory; it is not indeed impossible that one of them may be identical with that species.

The genus will be readily known by the very obtuse mandibles, the antennal pores visible only on the inferior margin, and the equal joints of the tarsi. On the lateral surfaces of the 7th and following joints of the antennæ is seen a deep elliptical fovea, on the

5th and 6th it is represented by a large puncture; I have seen nothing resembling this in any other species of the family. No external sexual characters.

1. P. Webbii Lec. Proc. Acad., 1858, 66. Ures, Sonora, Dr. T. H. Webb. The sides of the thorax in this species are moderately rounded and obtusely angulated, and the base is the widest part.

2. P. Woodhousei. *Dicerca Woodhousei* Lec. Proc. Acad., 6, 68.
Var. major, *P. valens* Lec. Proc. Acad., 1858, 66.

Creek boundary, Dr. S. W. Woodhouse: Texas, Mr. A. Schott. The specimens from Texas are of a larger size, and more robust form, and the ground color is darker, whereby the spots appear more brilliant, but I do not find any distinctly defined character upon which to separate them. It is readily known from P. Webbii by the thorax being widest at the middle, and very much rounded on the sides.

GROUP II.

In this group the sides of the posterior part of the prosternum are straight, or very feebly angulated, the apex is broad and obtusely rounded in most genera, but sometimes acute. The mesosternum is closely united to the metasternum by a transverse suture, and is broadly and deeply excavated through its whole length, for the reception of the prosternum, as in the preceding group. The antennal cavities are small, and the front is not lobed: the antennal pores are on the inferior edge, arranged in small foveæ, which in our genera are usually marginal, but in Cinyra terminal. The scutellum is small and rounded, rarely transverse: the elytra are not serrate in any of our species.

Our genera may be thus arranged.

Prosternum postice obtuse rotundatum;	
mentum totum corneum;	
scutellum parvum rotundatum -	Dicerca.
scutellum transversum - -	Poecilonota.
mentum antice membraneum - -	Ancylochira.
Prosternum postice acutum - - -	Cinyra.

Dicerca Esch.

The species of this genus are more numerous in the United States than has been suspected, and, in many instances, are very closely related in appearance, though it is believed that the notes given below, will enable them in every instance to be readily recognised. In this genus, as in Ancylochira, are found several species in which the ordinary sexual characters of the male are not observed. I have sought some mark by which these might form a separate group in the genus, but have not met with success: although they

may be isolated by characters to form a group of lower value than the three into which I divide the genus, and which may be thus distinguished.

A. Corpus elongatum, elytris oblique attenuatis et præcipue valde prolongatis, apice sæpissime integris; prosterno metasterno et abdominis segmento primo late sulcatis; mesosterno haud punctato; antennis articulis 2 et 3 æqualibus. Mares segmento ventrali ultimo truncato emarginato, tibiis intermediis intus late emarginatis, et supra medium dente magno armatis. Feminæ segmento ventrali rotundato, acute biinciso.

a. Elytra apice integra; abdomen art. ult. ventrali canaliculato lineis duabus lævibus munito. Sp. 1–3.

b. Elytra apice bidentata; abdomen art. ult. vix canaliculato - - - Sp. 4.

B. Corpus elongatum, elytris oblique attenuatis paulo vel vix prolongatis, apice bidentatis (excepta spec. 4,) abdominis segmento 1mo plus minusve sulcato; mesosterno haud vel vix punctato; antennis articulo 2ndo breviore. Mares segmento ventrali ultimo truncato emarginato, tibiis intermediis sæpissime intus late emarginatis et supra medium dente armatis. Feminæ sicut in A.

* Frons haud transversim carinata.

c. Metasternum sulcatum.

α. Prosternum convexum. - - - - - - Sp. 5.

β. Prosternum sulcatum. - - - - - - Sp. 6—9.

d. Metasternum haud sulcatum. - - - - - - Sp. 10—11.

* * e. Frons inter antennas transversim carinata. - - - - - Sp. 12.

C. Corpus crassiusculum, elytris oblique magis abrupte attenuatis et breviter prolongatis, integris vel vix bidentatis; antennis articulo 2ndo breviore. Sexus differentia varia.

* Abdomen segmento ventrali ultimo haud costato.

f. Sternum late sulcatum, mesosternum rude punctatum, (abdominis segmento ultimo maris truncato emarginato.) - - - - - - - - Sp. 13—15.

g. Sternum parum sulcatum, mesosternum parce punctatum (abdominis segmento ultimo maris?) Sp. 16–17.

h. Prosternum planum cum mesosterno dense punctatum, (abdominis segmento ultimo feminæ rotundato, maris truncato.) - - - - - - - - Sp. 18–20.

i. Sternum valde sulcatum, mesosternum parce punctatum, (abdominis segmento ultimo maris rotundato.) Sp. 21—22.

* * k. Abdomen segmento ultimo acute bicostato, (maris truncato, haud emarginato.) Sp. 23.

A.—a.

1. D. prolongata, griseo-ænea, sæpe pruinosa, thorace latitudine plus duplo breviore, lateribus antice valde rotundatis postice subsinuatis, punctato, canaliculato, utrinque pone medium oblique profunde impresso; elytris striis profundis, interstitiis spatiis oblongis obscurioribus lævibus parum elevatis, postice oblique attenuatis, prolongatis, apice rotundatis vix divaricatis; subtus parce pubescens. Long. ·77—·85.

Lake Superior, Nebraska, and Wisconsin. From the other species of this group, it differs by the thorax being shorter, much narrower and more rounded in front, more punctured, and with the dorsal channel and oblique impressions, more strongly marked. As in the neighbouring species, the pro- and metasternum, and first ventral segment are broadly and deeply sulcate, and the divided mesosternum very sparsely punctured: the last ventral segment has two smooth longitudinal spaces. The last ventral segment of the male is

tolerably deeply emarginate, and the middle tibiæ are armed with a large subacute internal tooth, the inferior margin of which, as well as the tibia, is distinctly serrate; the sternum is also more hairy than in the female. The last ventral segment of the female has the lateral teeth rounded, the middle one acute.

2. D. divaricata, ænea, vel aureo-ænea, sæpe pruinosa, thorace latitudine duplo breviore, lateribus antice rotundatis, postice subsinuatis, lateribus confluenter, medio discrete punctato, subcanaliculato, vittaque obsoleta sublævi utrinque notato, utrinque pone medium oblique impresso; elytris punctatis, striis internis distinctis, interstitiis alternis spatiis oblongis lævibus parum elevatis variegatis, postice oblique attenuatis, prolongatis, plus minusve divaricatis, subtruncatis, sutura prominula, subtus parum pubescens. Long. ·63—·90.

Lec. Agassiz' Lake Superior, 227: Fitch, Trans. Agr. Soc. New York, 1856, 366.

Buprestis divaricata Say, Journ. Acad. 3, 163: Trans. Am. Phil. Soc. 6, 158. *B.* (*Stenuris*) *div.* Kirby, Fauna Bor. Am. 154. *B.* (*Dicerca*) *div.* Harris, Ins. Inj. to Veg. 42.

Buprestis acuminata ‡ Lap. & Gory, Mon. Buprest. 2, 106, tab. 27, f. 145.

Dicerca dubia Mels. Proc. Acad. 2, 142.

Dicerca aurichalcea Mels. Proc. Acad. 2, 142.

Dicerca parumpunctata Mels. Proc. Acad. 2, 143.

Middle States, abundant: the larva burrows in the wood of the cherry and the beech. The thorax from the arrangement of the sculpture has the appearance of having 4 faint costæ. The sexual characters are as in D. prolongata, except that the inferior margin of the tooth of the middle tibiæ of the male is not as strongly serrate. The prolongations of the elytra vary somewhat in length and degree of divergence, and I have one specimen in which they are very short and closely applied to each other, but the edge of the elytra near the apex shows a fold, which must have resulted from an injury received in an earlier state of development. The specimens described by Dr. Melsheimer must all be referred to these individual variations. Say's description would leave it in doubt whether this or the next species were meant by him, but specimens were furnished by Dr. Harris to Mr. Kirby, and have been described by the latter sufficiently to attach the name to the species now under consideration. For this reason I have been obliged to reject the names of Dr. Melsheimer for this, and to propose a new name for the next species.

3. D. caudata, ænea, sæpe pruinosa, punctata, thorace latitudine sesqui breviore, a basi antrorsum angustato, lateribus late rotundatis, lateribus dense, medio discrete punctato, subcanaliculato, lineaque obsoletissima sublævi utrinque notato, et obsolete oblique impresso; elytris striis vix distinctis, interstitiis alternis spatiis oblongis lævibus variegatis, ad apicem valde prolongatis divaricatis, subtruncatis, sutura haud prominula. Long. ·6—·7.

Middle and Western states. I have received this species from Dr. Melsheimer as *D. divaricata*, but for reasons above given I cannot adopt his view. It only differs from the last by the form of the thorax, which is narrowed from the base to the apex by the less distinct elytral striae. The sexual characters are precisely as in the last.

A.—b.

4. D. pugionata, æneo-cuprea, thorace latitudine paulo breviore, antrorsum a basi paulo angustato, lateribus parum rotundatis, rude punctato, profunde canaliculato, costisque 4 sublævibus notato, externis interruptis, sæpe obsoletis, elytris striis punctatis, versus suturam distinctis, interstitiis spatiis lævibus nigricantibus parum elevatis variegatis, ad apicem valde prolongatis bidentatis. Long. ·45—·54.

Buprestis pugionata Germ. Ins. Nov., 57; (nec Laporte & Gory.)

Pennsylvania, Maryland: Dr. Melsheimer, and Mr. J. P. Wild. A pretty little species, very distinct from all others by the characters above given. The sternum and first ventral segment are sulcate as in the others of group (A,) the last ventral segment in one specimen is marked with two elevated lines more approximate than D. divaricata, but in two other specimens before me, I can scarcely perceive them. The tip in the female is tridentate, the middle tooth narrow, but rounded at the apex. The male is unknown to me.

B.—c, α.

5. D. mutica, longiuscula, griseo-ænea, thorace latitudine sesqui breviore, ante medium fortius angustato, et lateribus sinuato, fortiter, ad latera confluenter punctato, dorso canaliculato, elytris punctatis, striis internis distinctis, interstitiis spatiis obscuris variegatis, internis nitidis parce punctatis, postice oblique attenuatis, haud prolongatis, rotundatim truncatis, prosterno convexo, parce punctato, metasterno segmentoque ventrali primo sulcatis. Long. ·64.

Mas segmento ultimo ventrali rectangulariter inciso, dente emarginationis brevi lato recte truncato, tibiis intermediis rectis. Sexus altera latet.

One specimen from Brooklyn, New York, given me by Mr. J. Akhurst. Differs remarkably from all other species known to me; the sculpture of the elytra is exactly as in D. lurida.

B.—c, β.

6. D. obscura, griseo-ænea cuprascens, thorace latitudine sesqui breviore, a basi antrorsum angustato, lateribus late rotundatis, rude confluenter punctato, utrinque pone medium late impresso, costula obsoleta sublævi notato, medio parce punctato, sulco dorsali subinterrupto, elytris punctatis, striis versus suturam et apicem punctatis, interstitiis internis lævibus nigro variegatis, ad apicem sensim attenuatis bidentatis, parum prolongatis. Long. ·60—·75.

Mas tibiis intermediis simplicibus, abdominis segmento ventrali ultimo tridentato, dente intermedio brevissimo lato truncato.

Femina segmento ventrali ultimo tridentato, dente intermedio angusto acuto.

Buprestis obscura Fabr. Ent. Syst. 1, 2. 190: Syst. El. 2, 190. Herbst, Käfer, 9, 96; tab. 143, f. 5. Gory & Lap. Mon. Bupr. 2, 103; tab. 26, 141.

? Buprestis pruinosa Gory, Mon. Bupr. 4, 190; tab. 19, 106.

Massachusetts to Florida. Readily distinguished from all others but the two next, by the freedom from any conspicuous elevations, and by the thorax being narrowed from the

base: from the next, it differs by the sides being broadly rounded. Body beneath coppery, coarsely punctured, on the sides and abdomen, shining and sparsely punctured on the middle of the breast, and first ventral segment. The elytra towards the suture are polished, with the intervals smooth.

7. D. baltimorensis, griseo-ænea, thorace latitudine haud breviore, a basi antrorsum angustato lateribus omnino rectis, rude confluenter punctato, vitta utrinque obsoleta sublævi, medio parce punctato, sulco dorsali mediocri, elytris punctatis, striis versus suturam et apicem punctatis, interstitiis (internis lævibus) nigro-variegatis, ad apicem sensim attenuatis paulo prolongatis, bidentatis. Long. ·60.

Mas sicut in priore; femina ignota.

Buprestis baltimorensis Herbst, Käfer, 9, 99; tab. 148, fig. 7.

One specimen, New York. Narrower than D. obscura, with a somewhat longer tail, but differing more conspicuously by the entirely straight sides of the thorax and the somewhat deeper and more punctured dorsal channel. It may, however, be a matter of doubt if it eventually ranks as a distinct species.

8. D. soror, griseo-ænea, thorace latitudine breviore antice angustato, latèribus late rotundatis, rude punctato confluenter ad latera, parcius ad medium, vitta obsoleta utrinque sublævi, sulco dorsali densius punctato, haud profundo, elytris rugose punctatis, striis versus suturam et apicem fortius punctatis, interstitiis (internis parce punctatis) nigro-variegatis, ad apicem sensim attenuatis, haud prolongatis, bidentatis. Long. ·60.

One female, Pennsylvania. Also related to D. obscura, but with the apex of the elytra not prolonged, but only gradually narrowed, the striæ toward the suture more strongly punctured, the elevated spaces less regular, being rather the portions left between confluent punctures than oblong spaces: by the thorax being more equably punctured, with the dorsal channel stronger and more punctured, with the sides scarcely converging from the base to the middle; and finally by the sides of the abdomen being more densely punctured.

9. D. lurida, griseo-ænea, pruinosa, thorace latitudine paulo breviore, ante medium angustato, lateribus rotundatis, postice subsinuatis, lateribus confluenter, medio discrete punctato, vix obsolete canaliculato, ante scutellum foveato, elytris punctatis striis versum suturam distinctis, interstitiis spatiis obscuris variegatis, internis nitidis parce punctatis, postice oblique attenuatis haud prolongatis, bidentatis. Long. ·58—·78.

Mas segmento ventrali ultimo truncato-emarginato; tibiis intermediis intus obtus angulatis. Femina ano tridentato, dente intermedio acuto.

Buprestis lurida Fabr. Ent. Syst. 1, 2, 190; Syst. El. 2, 190. Oliv. Ins. 32, 20, tab. 8, fig. 83. Herbst, Käfer, 9, 95, tab. 143, fig. 4. Lap. and Gory, 2, 105, tab. 27, fig. 144.

Dicerca indistincta Mels. Proc. Acad. 2, 143.

Common in the Middle, Southern and Western States. Nothing need be added to the diagnosis above given, as the species is well known and readily distinguished. The thorax especially of the smaller males is obliquely and broadly impressed each side behind the middle. According to Dr. Harris, the larva lives in hickory wood. (Ins. Inj. to veg. 43.)

B.—d.

10. D. lepida, elongata, aureo-ænea, thorace latitudine breviore, antrorsum parum angustato, lateribus antice late rotundatis, confluenter punctato, trisulcato, vittis quatuor elevatis lævibus signato, elytris dense punctatis, stria suturali distincta, sutura elevata, interstitiis alternis spatiis elongatis nitidis elevatis ornatis, postice oblique longius attenuatis et paulo prolongatis, bidentatis. Long. ·60.

Mas abdominis segmento ventrali ultimo tridentato, dente intermedio breviore late truncato. Femina ano tridentato, dente intermedio acuto.

Lec. Proc. Acad. Nat. Sc. 1857, 7.

Buprestis pugionata ‡ Lap. & Gory, 2, 99, tab. 26, 136.

Alabama, Prof. Haldeman; Pennsylvania, Rev. D. Ziegler. A very beautiful and distinct species. This and the next differ from those of the previous division by the metasternum being almost flat, while the prosternum is deeply sulcate, and the first segment of the abdomen is moderately so. The under surface is coppery, densely and coarsely punctured at the sides, nearly smooth, or sparsely punctured at the middle. The middle tibiæ are entirely straight in both sexes. The head has a V shaped callus between the eyes and two occipital ones with an intervening channel.

11. D. spreta, minus elongata, cinereo-ænea, pruinosa, thorace latitudine sesqui breviore, ad medium latiore, lateribus antice rotundatis postice sinuatis, inæquali, rude punctato, callis nitidis ornato, medio polito, sulco dorsali antice profundo, postice subbiseriatim punctato, elytris dense punctatis, sutura elevata sublævi variegata, interstitiis callis oblongis obscuris elevatis ornatis, postice oblique attenuatis paulo prolongatis, bidentatis. Long. ·60—·66.

Mas segmento ventrali ultimo tridentato, dente medio breviore lato truncato. Femina segmento ventrali ultimo tridentato, dente medio acuto.

Buprestis spreta Gory, Mon. Buprest. 4, 108, tab. 19, fig. 105.

Dicerca molitor Mels. Proc. Acad. Nat. Sc. 2, 143.

Middle States, not common. I incorrectly placed Melsheimer's references as synonyms to the next species in my index to Laporte and Gory's species, (Proc. Acad. 1857, 7,) being deceived by the wretched description of these last mentioned authors. The front between the eyes is marked with a smooth concave callus in the middle and a smaller one each side, forming an irregular elevated line: the thorax is deeply impressed each side behind the middle, and the surface is very uneven at the sides: the external costæ are irregular and interrupted, and the dorsal canal is deeper at the apex; the smooth costæ limiting it are broad. The middle tibiæ are straight in both sexes. The under surface is coarsely and densely punctured at the sides, nearly smooth in the middle: the metasternum is scarcely channeled, and the broad deep groove of the prosternum is coarsely punctured.

This species has a more robust form than the others of group B, being proportioned almost as D. punctulata, but differs from those of group C by the strongly bidentate elytra.

B.—e.

12. D. asperata, cinereo-ænea, fronte late concava, carina transversa inter antennas signata, thorace latitudine sesqui breviore, lateribus antice rotundatis, postice parallelis, rude punctato, inæquali, vittis quatuor (externis angustis) nitidis lævibus, sulco dorsali plaga lævi interrupto, parte postica profundiore, elytris dense punctatis, striis punctis fortioribus notatis, interstitiis plagis paucis oblongis nigris notatis, postice oblique angustatis, vix prolongatis, bidentatis. Long. ·62—·70.

Buprestis asperata Lap. & Gory, 2, 105, tab. 27, fig. 143.

Dicerca impressifrons Mels. Proc. Acad. Nat. Sc. 2, 144.

?*Buprestis americana* Herbst, Käfer, 9, 107, tab. 148, fig. 3.

Middle and Southern States, rare. The tip of the abdomen of the male is truncate and emarginate, and the middle tibiæ are armed internally with a large tooth. The female has the tip of the abdomen tridentate, and the middle tooth rounded at tip.

This species was first well described by Dr. Melsheimer; Laporte and Gory's figure and description are as usual very poor. The description by Herbst is somewhat indefinite, and it is difficult to know whether it should refer to this or to D. chrysea of the division C.

In addition to the characters given in the diagnosis I may mention that the head is transversely elevated between the eyes; the occiput has two smooth elevations; the external smooth vittæ of the thorax are narrow, but entire, the dorsal channel is punctured, and is interrupted by an elongate smooth elevation, behind which it is deeper than in front. The pectoral groove is very deep in the male, shallow in the female, and the antepectus is hairy in both sexes.

C.—f.

13. D. tenebrosa, cinereo-ænea, vel obscure ænea, thorace latitudine plus duplo latiore, lateribus dilatatis, antice rotundatis postice sinuatis, rude punctato, postice utrinque late excavato, callis utrinque apicalibus et basalibus lævibus nitidis, sulco dorsali profundo costis lævibus definito, medio subinterrupto, elytris dense punctatis, interstitiis alternis spatiis oblongis elevatis nitidis variegatis, ad apicem prolongatis integris. Long. ·57—·75.

Mas pectore late sulcato villoso, tibiis intermediis dente interno acuto armatis, segmento ventrali ultimo truncato-emarginato.

Femina pectore subglabro minus sulcato, segmento ventrali ultimo tridentato, dente intermedio obtuso, incisuris minutis definito.

Buprestis (*Stenuris*) *tenebrosa* Kirby, Fauna Bor. Am. 155.

Abundant at Lake Superior; according to Kirby found in Lat. 65° and in the Rocky Mountains. The suture in this and in all the following species is elevated. In addition to the characters given in the diagnosis, it may be mentioned that the under surface is copper coloured, coarsely and densely punctured on the sides, abdomen and prosternum, less densely on the metasternum and middle of the first segment of the abdomen: the divided portions of the mesosternum are coarsely, and tolerably densely punctured. The outer costæ of the thorax are interrupted so as to form on each side an apical and basal cal-

losity. A female from Newfoundland differs by the epipleuræ being green, the under surface of the prolonged extremity of the elytra, blue, and by the incisures between the anal teeth being more widely separated.

14. D. hilaris, cinereo-ænea, capite thoraceque viridi tinctis, hoc latitudine plus duplo breviore, lateribus dilatatis rotundatis, postice sinuatis, rude punctato, inæquali, vittis quatuor nitidis elevatis, externis subinterruptis, sulco dorsali callo parvo nitido interrupto, elytris punctatis, striis internis punctatis, interstitiis alternis spatiis oblongis nitidis elevatis ornatis, ad apicem paulo prolongatis integris, pectore late sulcato subglabro. Long. ·60.

Mas tibiis intermediis rectis, segmento ventrali ultimo truncato emarginato. Femina segmento ventrali ultimo apice rotundato.

A male found at New York by Mr. H. Ulke; a female found at Brooklyn, N. Y., given me by Mr. Akhurst. This species is very similar to the preceding, and apart from the sexual characters differs only by the lateral vittæ of the thorax being narrower and less interrupted, not being divided into two rounded callosities, and by the elytra being less prolonged at the apex. The middle of the metasternum is also less punctured, the epipleuræ are tinged with green, and the under surface of the tips of the elytra with blue; the body beneath is golden coppery.

15. D. lugubris, supra nigro-ænea, thorace latitudine plus duplo breviore, lateribus dilatatis valde rotundatis postice sinuatis, rude punctato, inæquali, callo laterali magis distincto, vitta externa elevata interrupta, sulco dorsali profundo callo parvo medio interrupto, elytris fere opacis punctatis, striis fortius punctatis haud impressis, interstitiis 3 et 5 spatiis paucis nitidis elevatis, ad apicem longius prolongatis rotundatis. Long. ·62.

Mas pectore late sulcato, subglabro, tibiis intermediis rectis, segmento ventrali ultimo truncato emarginato. Femina latet.

One specimen, Marquette, Lake Superior. Differs from the two preceding, as well by the deeper dorsal thoracic channel, as by the elytra being more equally punctured, with obvious rows of large punctures, with very few smooth elevated spaces, and also by the extremity being more prolonged.

The colour beneath is dark coppery, and the punctures are hardly less numerous in the middle than at the sides.

16. D. chrysea, læte æneo-cuprea, thorace latitudine duplo breviore, lateribus postice parallelis antice obtuse angulatim rotundatis, rude punctato, postice utrinque late excavato, callo laterali altero utrinque apicali costisque duabus nitidis, sulco dorsali callo medio interrupto, elytris dense punctatis, striis punctatis parum distinctis, interstitiis alternis spatiis elevatis nitidis variegatis, ad apicem breviter prolongatis subemarginatis. Long. ·57—·70.

Femina segmento ventrali ultimo tridentato, dente medio latiore rotundato. Mas abdominis segmento ventrali ultimo truncato emarginato, tibiis intermediis intus obtuse angulatis.

Melsheimer, Proc. Acad. Nat. Sc. 2, 143.

Middle and Southern States, rare: the male was found in New Hampshire by Dr. Harris. From the other species which it resembles in sculpture it may be known by the body being more coarsely and less densely punctured beneath; the prosternum is less

punctured than in the species of the other groups of this division, is broadly sulcate, and has two smooth lines as in division B; the mesosternum has on its prominent divided portions only a few distinct punctures: the metasternum and middle of first ventral segment are sparingly punctured. The outer costa of the thorax in this species is so interrupted by the excavation as to leave a large anterior callus, while the posterior portion is very short and adheres to the basal margin.

17. D. punctulata, supra cinereo-nigra, subænea, thorace latitudine sesqui breviore, lateribus postice subangulatim rotundatis, dense punctato, costis quatuor angustis nitidis externis interruptis, postice utrinque late excavato, elytris basi thorace paulo latioribus dense punctatis, punctis magnis seriatis notatis, versus suturam subnitidis, interstitiis alternis spatiis paucis parvis elevatis nitidis, ad apicem subprolongatis rotundatis. Long. ·50–·64.

Femina? segmento ultimo ventrali ad apicem rotundato. Mas latet.

Fitch, Trans. N. Y. State Agric. Soc. 1857, 706.

Buprestis punctulata Schönherr, Syn. Ins. App. 123. Lap & Gory, Mon. Buprest. 2, 99, tab. 25, fig. 134. Mels. Proc. Acad. Nat. Sc. 2, 145.

Buprestis transversa Say, Ann. Lyc. of New York, 1, 219.

New York to Georgia; not rare in pine forests. Beneath very shining black bronzed: pectoral channel shallow, not extending upon the first ventral segment; body coarsely and densely punctured at the sides, sparsely at the middle; prosternum with the groove more punctured than the elevations: mesosternum sparsely punctured.

C.—h.

18. D. manca, cinereo-ænea, thorace latitudine sesqui breviore, lateribus parum dilatatis, antice rotundatis, postice sinuatis, rude punctato, postice utrinque late excavato, callo laterali alteris utrinque ad apicem et basin lævibus, sulco dorsali callo medio interrupto, costisque parce punctatis definito, elytris punctatis striis punctatis versus suturam distinctis, interstitiis alternis spatiis elevatis et rugis transversis lævibus variegatis, ad apicem prolongatis truncatis. Long. ·72.

Femina abdominis segmento ultimo apice rotundato. Mas latet.

One male found at New York by Mr. H. Ulke. Very similar in appearance to D. tenebrosa and hilaris, but apart from the sexual characters, the prosternum is altogether flat, not hairy, and the first segment of the abdomen is not sulcate. The mesosternum is coarsely punctured as in those species, but not so densely as in the next. The elytra are also rough with shining transverse elevated wrinkles, not seen in the two species mentioned.

19. D. tuberculata, ænea, thorace latitudine duplo breviore, lateribus valde dilatatis, antice valde rotundatis, postice sinuatis, rude punctato inæquali, carina brevi ad angulum posticum, callis ad apicem et basin costisque duabus sublævibus, sulco dorsali lato et profundo, callo parvo medio notato, elytris punctatis, striis internis grosse punctatis, interstitiis alternis spatiis elevatis nitidis ornatis rugis elevatis transversis pluribus connexis, postice breviter prolongatis rotundatis. Long. ·52—·64.

Femina abdominis segmento ultimo apice rotundato. Mas segmento ventrali ultimo truncato emarginato, tibiis simplicibus.

Fitch, Trans. N. Y. State Agric. Soc. 1857, 706.

Buprestis tuberculata Lap. and Gory, Mon. Bupr. 2, 92; tab. 25, f. 135.

Dicerca scobina Chevr. Silbermann's Rev. Ent. 5, 66.

Dicerca consobrina Mels. Proc. Acad. 2, 145.

Maine, Dr. T. W. Harris: also occurs in New York. The body beneath is bright coppery, the prosternum flat, densely punctured, the mesosternum coarsely and tolerably densely, the feebly sulcate metasternum and middle of first ventral segment sparsely punctured, the latter not sulcate.

20. D. lacustris, nigro-fusca, subænea, thorace latitudine duplo breviore, lateribus modice dilatatis, antice rotundatis postice sinuatis, densè punctato, carina postica ad angulum, costisque quatuor sublævibus, externis late interruptis, postice utrinque late excavato, sulco dorsali profundo callo parvo medio notato, elytris dense punctatis, striis fortiter punctatis, interstitiis alternis spatiis paucis nitidis parum elevatis, postice longius prolongatis rotundatis. Long. ·66.

Femina abdominis segmento ultimo apice rotundato. Mas latet.

?*Buprestis* (*Stenuris*) *tenebrica* Kirby, Fauna Bor. Am. 156.

Lake Superior, on Point Kewenaw. Resembles in general appearance D. punctulata, but the sides of the thorax are dilated, and therefore more rounded, and the elytra are considerably prolonged at the apex. The body beneath is dark coppery, coarsely and densely punctured, except on the metasternum and middle of the first ventral segment, where the punctures are less dense. The prosternum is nearly flat, the metasternum broadly slightly concave, the first ventral segment not sulcate.

I am doubtful in regard to the propriety of regarding this as Kirby's species, because he states that the thorax is without smooth elevations, and that the smooth spaces of the elytra are near the outer margin.

21. D. bifoveata, atra, vix ænea, thorace latitudine duplo latiore, lateribus dilatatis antice valde rotundatis postice breviter sinuatis, rude punctato, carina postica ad angulum, callis ad apicem et basin costisque duabus sublævibus, utrinque pone medium profunde excavato, sulco dorsali profundo, callo medio interrupto, elytris dense punctatis, striis fortiter punctatis, interstitiis alternis spatiis paucis nitidis subelevatis, postice vix prolongatis subtruncatis. Long. ·51.

Femina abdominis segmento ultimo ventrali minute biinciso.

One specimen, Lake Superior. Also resembles the last species, but the elytra are less prolonged, the thorax is more dilated on the sides. The body beneath is coarsely but not very densely punctured, the prosternum slightly sulcate, the mesosternum very coarsely punctured, the metasternum a little less punctured, broadly concave; first ventral segment less punctured at the middle, sulcate only at the base.

22. D. crassicollis, obscure cinereo-ænea, thorace latitudine plus duplo breviore, lateribus valde dilatatis,

postice sinuatis, pone medium utrinque late excavato, costis quatuor, externis interruptis, sulco dorsali profundo callo parvo sæpe notato, elytris dense punctatis, striis fortiter punctatis, interstitiis alternis spatiis nitidis elevatis ornatis, postice breviter prolongatis, truncatis. Long. ·60—·68.

Mas abdominis segmento ultimo ventrali apice rotundato. Femina tridentato, dente medio angusto obtuso.

Lec. Report of Pac. R. R. Expl. and Surveys, 47th Par. insects, 45.

Washington Territory, Dr. Suckley, California, Mr. J. Child. Resembles in appearance D. tenebrosa, but the thorax is much more dilated on the sides. The body beneath is purple bronzed, coarsely punctured, with the metathorax and middle of first ventral segment more sparingly punctured. Pectoral groove deep, extending on the first ventral segment, mesosternum very coarsely, but not densely punctured.

C.—k.

23. D. pectorosa, nigro-fusco-ænea, thorace latitudine plus duplo breviore, lateribus valde rotundato-dilatatis, postice breviter sinuatis, inæquali grosse punctato, bicostato, sulco dorsali magno, elytris rugosis et dense punctatis, striis foveatim punctatis, interstitiis alternis spatiis nitidis parum elevatis parcis variegatis, postice longius prolongatis rotundatis. Long. ·64.

Mas segmento ventrali ultimo truncato, tibiis intermediis rectis. Femina latet.

Lec. Pacific R. R. Expl. & Surveys, vol. ix. (49th Par.) Insects, 45.

One male, Oregon, Dr. Suckley. Body beneath dark brassy, very coarsely punctured. Prosternum with two smooth, strongly elevated costæ, pectoral groove broad, deep and densely punctured: mesosternum coarsely punctured: metasternum almost as strongly sulcate as the prosternum, sparsely punctured at the middle: first ventral segment broadly sulcate, sparsely punctured at the middle: last ventral segment with two narrow costæ, between which at the tip is a very short and smaller one: the apex is truncate and marked with four deep subapical foveæ.

The following species belonging to the genus is unknown to me:

24. D. Lecontei, 'cinereo-argentata, thorace inæquali, elytris punctatis, maculis nigro-velutinis.' Long. ·33.

Buprestis Lecontei Gory, Mon. Buprest. 4, 107, tab. 18, fig. 104.

D'un cendré argenté. Antennes cuivreuses. Tête finement ponctuée, avec de petites élévations irregulières, et recouverte d'une pubescence argentée. Corselet presque carré, avec ses angles postérieurs très aigus, couvert d'élévations irrégulières, dont la plus forte est sur son milieu, avec une profonde impression dessus. Elytres granuleuses, avec des rangées de points disposés en lignes longitudinales, qui les font paraître striées, surtout près de la suture: elles sont rebordés près de leur base, et ont en outre quelques taches d'un noir velouté. Cette charmante espèce . . . . doit être placèe après la *Punctulata*.'

PŒCILONOTA Esch.

The species of this genus, present all the essential characters of Dicerca, except that

the scutellum is very transverse, and truncate, with the posterior angles well marked. Lacordaire adds other slight differences, but some of them are now to be rescinded, since the elytra are caudate in P. cyanipes, and the prosternum is not canaliculate in several species of Dicerca. The characters drawn from the antennæ, of which the 3rd joint is twice as long as the 2nd, and the 4th is triangular, and nearly as broad as the 5th, still continue good. Our species are all marked with a smooth dorsal thoracic line, the antennal cavities are connected by a slight ridge, and the prosternum is hairy, characters never seen in Dicerca:

Elytra prolongata, integra - - - - - -	P. cyanipes.
(Elytra prolongata bidentata - - - - - -	P. erecta.)
Elytra haud prolongata, bidentata.	
Elytra depressa - - - - - - -	P. ferrea.
Elytra æqualiter convexa;	
Abdomen apice emarginatum - - - - -	P. thureura.
Abdomen (♂) apice integrum - - - - -	P. debilis.

1. P. cyanipes. *Buprestis cyanipes* Say, Journ. Acad. Nat. Sc. 3, 164.

Missouri, Mr. Maurice Schuster; New York, Mr. Akhurst.

2. P. erecta. *Buprestis erecta* Gory & Lap. 4, 110; tab. 19, f. 108.

Unknown to me; it seems related to the preceding, but the sides of the thorax of the figure are more rounded, and the tips of the elytra are bidentate.

3. P. ferrea, depressa, griseo-ænea, capite linea occipitali lævi, thorace transverso antrorsum angustato, lateribus medio subangulatis, costa dorsali lævi, callo utrinque antico, alteroque basali parum distincto, grosse subconfluenter punctato, versus latera late impresso, elytris striis hic inde præcipue introrsum distinctis punctatis, spatiis magnis punctatis, alterisque elevatis lævibus obscurioribus notatis, postice attenuatis bidentatis. Long. ·6.

Mas abdominis segmento ultimo profunde et late emarginato; prosterno hirto.

Dicerca ferrea Mels. Proc. Acad. 2, 144.

One specimen from the Western States, Mr. Wild: others were found by Mr. Schuster in Missouri. This species differs from P. thureura by the narrow form, and more flattened thorax and elytra: the sides of the thorax diverge a little from the base, so that the widest part is about the middle.

4. P. thureura. *Buprestis thureura* Say, New Ins. of Louisiana, 3.

Buprestis costicollis Gory & Lap. 4, 109, tab. 19, f. 107.

Very abundant in Louisiana. The prosternum of the male is very hairy, and the last segment of the abdomen broadly and deeply emarginate. In the female the same segment is very slightly emarginate.

5. P. debilis, cupreo-ænea, thorace subtransverso, a basi antrorsum angustato, lateribus late rotundatis, rude punctato, costa dorsali latiuscula lævi, alteraque utrinque vix distincta, elytris striatis, præcipue confertim punctatis, spatiis obscuris lævibus variegatis, ad apicem truncatis vix bidentatis, abdominis apice integro. Long. ·48.

One specimen, Baltimore, Mr. Wild. I was inclined to believe this a very small specimen of P. thureura, and on comparison I find no satisfactory character except size upon which to rest its distinction. Nevertheless the last joint of the abdomen is rounded at the tip, which distinguishes it at once from either sex of the preceding. From the absence of hair on the prosternum, I suppose that the specimen is a female.

Ancylochira Esch.

Kiesenwetter, (Ins. Deutsch, 4, 50) states that the first and second ventral segments of the abdomen are not connate, but after examining all of our species, I find no grounds for this assertion, those segments being united as usual, with the suture, however, less obliterated at the middle than is customary. The diagnosis of the genus as given by him should also be modified, so as to exclude the sexual character drawn from the anterior tibiæ of the male, since in a considerable group of the genus (represented in Europe by A. splendida) this distinction between the sexes is not found.

Our species may be arranged as follows.

A. Prosternum haud vel vix breviter sulcatum; tibiæ anticæ maris intus emarginatæ et unco reflexo apicali armatæ: (Sp. 4 & 5 exceptis.)

a. Abdomen articulo primo haud sulcato - - - - - Sp. 1—6.

b. Abdomen articulo primo sulcato - - - - - - Sp. 7—15.

B. Prosternum late sulcatum; tibiæ anticæ sexus utriusque simplices.

c. Elytra costis quatuor sutura margineque elevatis - - - - Sp. 16—20.

d. Elytra punctato-striata - - - - - - - Sp. 21—23.

A.—a.

1. A. rufipes *Dej.* Cat. 88. *Buprestis rufipes* Fabr. Ent. Syst. 1, 2, 188: Syst. El. 2, 188. Oliv. 32, 16, tab. 7, f. 73. Say, Am. Ent. pl. 26. Lap. & Gory, 2, 139, tab. 34, 191.

New York to Louisiana. In the male the last segment of the abdomen is broadly truncate and bidentate: in the female it is sinuous, and also bidentate, with a smaller medial acute tooth.

2. A. Gibbsii *Lec.* Pac. R. R. Reports, 47 Par. Ins. 42, tab. 1, f. 17.

Steilacoom, W. T., Mr. George Gibbs. The tip of the abdomen of the male is truncate, not bidentate.

3. A. sexplagiata, læte viridi-æenea, thorace confertim punctato, obsolete canaliculato, antrorsum angustato, elytris nigris, macula oblonga magna antica, alterisque transversis posticis duabus flavis, margine basali viridiæneo, profunde striatis apice bidentatis. Long. ·43—54.

Vermont and Northern New York. Head, thorax, body and legs of a uniform bright golden green. Antennæ obscure bronze. Head and thorax densely punctured, the for-

mer with a short occipital impressed line, the latter obsoletely channeled, wider than long, gradually narrowed from the base forwards, slightly rounded on the sides. Elytra purple black, with the basal margin golden green: they are ornamented with a large oblong spot at the base, extending one third the length, and nearly attaining the suture: it sometimes emits a slender external branch so as to enclose the humeral callus: just behind the middle is a transverse sinuous spot sometimes reaching the suture, and then connected with the third spot, which is near the tip. The striæ are deep and slightly punctured: the intervals convex, smooth, with a few small scattered punctures, especially towards the base and sides: the tip is truncate and bidentate. The tip of the abdomen of the female is broadly and very slightly emarginate, with the angles distinct, though not prominent. The male is unknown.

4. A. Langii *Lec.* Pac. R. R. Report, 47th Par. Ins. 42: tab. 1, f. 16. *Buprestis Langii* Mann. Bull. Mosc. 1843, 237.

Oregon and Washington Territories; Dr. J. G. Cooper, and Mr. George Gibbs. Allied to the next species, but narrower and more depressed, with the striæ of the elytra deeper, and more punctured, and the intervals narrower and more convex. The elytra are usually immaculate. The tip of the abdomen of the female is truncate; of the male broadly rounded, sinuate each side, with the angles slightly prominent. Anterior tibiæ simple.

5. A. fasciata *Dej.* Cat., 88. *Buprestis fasciata* Fabr. Ent. Syst. 1, 2, 191; Syst. El. 2, 191: Oliv. Ins. 32, 21, tab. 9, f. 92: Herbst, Käfer, 9, 162, tab. 145, f. 12. Say, Am. Ent. tab. 26: Lap. & Gory, 2, 144, tab. 35, 198: Kirby, Fauna Bor. Am. 154. *Buprestis sexmaculata* Herbst, Käfer, 9, 163, tab. 148, f. 5.

Not rare, especially in the northern portions of the Atlantic States; varies in colour from green to blue, and also in the size of the markings of the elytra. The tip of the abdomen of the female is truncate; in the male it is truncate and bisinuate: the anterior tibiæ are simple.

6. A. confluens. *Buprestis confluenta* Say, Journ. Acad. 3, 159: Am. Ent. tab. 26.

Kansas and Nebraska. In the male a broad yellow vitta extends from the anterior margin of the prosternum almost to the end of the first segment of the abdomen: the last segment of the latter is semicircularly emarginate, and has a small yellow spot each side about the middle. In the female the tip is feebly emarginate, without prominent angles.

A.—b.

7. A. lineata *Dej.* Cat., 88. *Buprestis lineata* Fabr. Ent. Syst. 1, 2, 192: Syst. El. 2, 192. Oliv. Ins. 32, 28, tab. 8, fig. 80.

Var. *Buprestis maculipennis* Gory, Mon. Bup. 4, 119, tab. 21, 117.

B. inconstans Mels. Proc. Acad. 2, 146.

Middle and Southern States not rare. Varies very much in the fulvous markings of

the elytra, which are normally two broad vittæ upon each; the extreme variation is where the outer vitta is broken into three spots, and the inner one into two; the two anterior spots are then connected by a transverse line forming a hamate spot. The tip of the abdomen in the male is truncate, with a little tooth each side; in the female, it is broadly rounded, but the same teeth are seen. The under surface is dull bronze, with the head and anterior margin of the prosternum fulvous.

8. A. læviventris *Lec.* Pac. R. R. Reports, 47th Par. Ins. 43.

Northern California, Mr. Child. Remarkably distinct from the other species of this group by the feeble punctuation of the abdomen: the tip of the abdomen in the female is broadly rounded, with an acute tooth each side.

9. A. Nuttalli. *Buprestis* (*Anoplis*) *Nuttalli* Kirby, Fauna Bor. Am. 152.

Lake Superior, one female: found according to Kirby in lat. 65°, and in the Rocky Mountains. I was inclined to consider Kirby's species as identical with A. consularis, but upon reviewing the matter, I find that no mention is made in his description of the sternal yellow markings so conspicuous in A. consularis, nor is the thorax said to be sinuate on the sides, a character very obvious in the last mentioned species. I therefore consider, under the present name, a species which is broader than A. consularis, with the sides of the thorax broadly rounded, and margined with yellow; the striæ of the elytra are deeper, and the intervals more distinctly punctured; the spots are two in number, of a reddish colour, with some very small lines near the base: the prosternum is immaculate; the coxæ and femora are partly red; the abdomen has a lateral red spot on each segment, the antepenultimate and penultimate have two discoidal spots, and finally the broad groove of the first segment becomes indistinct posteriorly, while in A. consularis it extends to the hind margin of the segment. The tip of the abdomen is truncate in the female, without prominent teeth.

10. A. consularis *Dej.* Cat. 88. *Buprestis consularis* Gory, Mon. Bupr. 4, 120, tab. 21, 118.

Northern New York, abundant. The sinuate side of the thorax, the spots of the elytra always broken up into little lines, the spotted prosternum, and the groove of the base of the abdomen extending the whole length of the first segment will distinguish this from the preceding. The last segment of the abdomen is broadly truncate in both sexes, with the angles minute, but distinct.

11. A. alternans, nigro-ænea nitida, thorace antrorsum angustato lateribus subsinuato, rude punctato, linea dorsali, callisque nonnullis lævibus, elytris striatis, vix parce punctatis, interstitiis alternis convexis, macula ante medium, altera mox pone medium, lineolisque pone basin paucis pallidis, apice truncatis, subdentatis, abdomine punctato, segmento 1mo sulcato, 3io et 4to guttis discoidalibus duabus, ultimo macula utrinque transversa rubris ornatis. Long. ·75.

One female, Santa Fe, Mr. Fendler. Also nearly related to A. consularis, but broader, with the sides of the thorax only slightly sinuous. The elytra, as in it, are marked with only a few scattered punctures. The only spots seen beneath are two small discoidal ones on the antepenultimate and penultimate ventral segments, and a transverse one each side of the last segment, extending to the margin. The tip is truncate, with the angles not prominent.

12. A. subornata, latiuscula, supra nigro-ænea, vel viridiænea, fronte antice fulvo-maculata, thorace antrorsum angustato, lateribus rectis, punctato, linea dorsali angusta lævi, elytris apice fere rotundatis, striatis, interstitiis punctis paucis notatis, alternis paulo elevatis, abdominis segmento 1mo late, 2 et 3 obsolete sulcatis, 2–4 utrinque maculis duabus fulvis plus minusve conjunctis, 5to maculis duabus transversis ornato. Long. ·7—·8.

California and New Mexico. Nearly related to the next, but broader, with the sides of the thorax straight, the dorsal line narrower and the other elevations very indistinct: the 3d and 4th segments of the abdomen and sometimes the second, have moreover two discoidal orange-coloured spots connected more or less with the lateral ones. The punctuation of the middle of the abdomen is less strong than in the next, and the 2nd and 3rd segments are feebly sulcate. The last segment of the female is truncate, with scarcely prominent angles.

The specimen from New Mexico is black bronzed, that from California is of a tolerably brilliant green above and bronzed beneath.

13. A. maculiventris. *Buprestis maculiventris* Say, Long's Exp. to St. Peter's River, 2, 272. *B. sexnotata* Lap. & Gory, Mon. Buprest. 2, 129, tab. 32, f. 178.

Pennsylvania, Lake Superior and Newfoundland. The sides of the thorax are rounded and suddenly incurved posteriorly. The last ventral segment of the abdomen is broadly rounded, with a small but distinct tooth each side.

The head has usually only a small yellow spot above the antennæ. In one female there is besides a large trilobed spot between the antennæ, and a spot each side adjoining the upper part of the eye: in it the last ventral segment is broadly truncate, without any teeth, and I am inclined to believe that it will eventually prove to belong to a distinct species.

Laporte and Gory's figure and description represent a brighter coloured individual than any before me, but not more so than the variety of the preceding species above mentioned.

14. A. rusticorum, nigro-ænea, subnitida, capite guttis fulvis notato, thorace latitudine breviore, antrorsum angustato, lateribus late rotundatis postice incurvis, punctato, linea dorsali callisque pluribus lævibus, angulis anticis fulvis, elytris apice subtruncatis striatis, interstitiis punctis paucis notatis, alternis paulo elevatis, abdomine fortiter punctato, segmento 1mo sulcato, ultimo maculis duabus fulvis ornato. Long. ·65—·92.

Buprestis (Anoplis) rusticorum Kirby, Fauna Bor. Am. 151.

Buprestis rusticorum Gory, Mon. Bupr. 4, 117, tab. 20, f. 115. Mannerheim, Bull. Mosc. 1843, 237.

Oregon and Washington Territories; abundant. Nearly allied to the preceding, but differs by the sides of the thorax being considerably more rounded, and by the head having spots between the antennæ, sometimes united into a trilobed spot, and at the upper part of the eyes: these latter spots sometimes extend inward so as to form an interrupted band. The lateral spots of the abdomen are small and frequently wanting except on the last segment, where they are large and frequently unite to form a transverse band.

The apex of the abdomen of the male is broadly emarginate, and the anal plate is subacuminate: the spots of the head in my specimen are larger and confluent, so that the face is fulvous, with two black frontal spots, but this is probably an individual, and not a sexual character.

In the female the apex of the abdomen is truncate, without prominent angles.

Kirby states in his description that there are two distinct anal teeth: this character would throw some doubt upon the correctness of my determination. There is however no other to which his description will apply, and the discrepancy can be understood if it be supposed that his specimen was a male.

15. A. paganorum. *Buprestis (Anoplis) paganorum* Kirby, Fauna Bor. Am. 152.

Found in Lat. 54°; unknown to me, but probably, from its resemblance to the preceding, belonging to this division: from the allied species, it differs by the thorax being constricted anteriorly, and furnished with a dorsal channel.

B.—c.

16. A. sulcicollis, supra obscure æneo-viridis, latiuscula convexa, thorace grosse dense punctato, profunde canaliculato, antrorsum angustato, lateribus medio fere angulatis, postice sinuatis, elytris dense rugose punctatis, sutura, costula scutellari, margine, costisque 4 valde elevatis lævibus, 3ia valde abbreviata, ad apicem subprolongatis, truncatis, subtus viridi-ænea. Long. ·62.

One specimen, Lake Superior. Related to the next, but much stouter and more convex, like A. lauta, but from that as from the others it is readily distinguished by the deeply channelled thorax, which is angulated on the sides, and by the elytra obliquely narrowed and slightly prolonged at the apex, with the 3rd costa very short. The tip of the abdomen is broadly rounded.

17. A. striata. *Buprestis striata* Fabr. Ent. Syst. 1, 2, 191; Syst. El. 2, 192. Oliv. Ins. 32, 15, tab. 7, fig. 77. Herbst, Käfer, 9, 187, tab. 140, fig. 8. Lap. & Gory, Mon. Buprest. 2, 147, tab. 37, fig. 202.

Buprestis impedita Say, Trans. Am. Phil. Soc. 6, 160. Lap. & Gory, 2, 148, tab. 26, fig. 203.

'*Buprestis aurulenta* Linn.' Oliv. Ins. 32, 18, tab. 9, 98. Herbst, Käfer, 9, 129, tab. 149, fig. 9. Lap. & Gory, 2, 146, tab. 36, 200.

Ancylochira aurulenta Kiesenwetter, Ins. Deutschl. 4, 57.

Middle States, Canada, and Lake Superior. Varies in brilliancy of colour; the second synonym belongs to the dull-coloured variety. The male is narrower than the female, and has the tip of the abdoman more distinctly truncate, or rather, more broadly rounded.

I cannot adopt the views of those authors who consider this species as B. aurulenta *Linn.* The description (Syst. Nat. 1, 661) makes no mention of the elytral costæ, and applies more nearly to A. decora than to the present. In this state of confusion the name shonld be either applied to that species, or dropped entirely.

18. A. lauta *Lec.* Proc. Acad. Nat. Sc. 7, 17; Pac. R. R. Reports, 47th Par. 43.

Oregon and Washington Territories, abundant. The male is a little narrower than the female, but the tip of the abdomen is subtruncate in both.

19. A. radians *Lec.* Proc. Acad. Nat. Sc. 7, 17; Pac. R. R. Reports, 47th Par. Ins. 44.

One specimen, Oregon, Dr. Cooper. Shaped like the male of A. lauta, but known by the very hairy front and prosternum. The tip of the abdomen is subtruncate.

20. A. adjecta *Lec.* Proc. Acad. Nat. Sc. 7, 17; Pac. R. R. Reports, 47th Par. Ins. 43.

One specimen, Oregon, Dr. Cooper. Broader even than the female of A. lauta, with intermediate elevated costæ on the elytra; the tip of the latter is distinctly bidentate. The abdomen is less strongly punctured, and scarcely truncate.

B.—d.

21. A. decora *Dej.* Cat. 88. *Buprestis decora* Oliv. Ins. 32, 18, tab. 8, fig. 82. Fabr. Ent. Syst. 1, 2, 189; Syst. El. 2, 189. Herbst, Käfer, 9, 128, tab. 149, f. 8. Lap. & Gory, Mon. Buprest. 2, 145, tab. 36, fig. 199.
Buprestis Salisburiensis Weber, Ent. Bemerk. 31; Obs. Ent. 73. Herbst, Käfer, 9, 174, tab. 148, fig. 8.
? *Buprestis aurulenta* Linn. Syst. Nat. 1, 661.

Middle and Southern States, not rare. The tip of the abdomen is truncate, subsinuate and bidentate in the male, subtruncate in the female.

22. A. ultramarina. *Buprestis ultramarina* Say, Trans. Am. Phil. Soc. 6, 160.

One female, Georgia. Say's description was made only from the elytra, but the species I refer to under this name, is of a broader form than A. decora, with the intervals of the elytra less irregularly punctured, especially towards the suture, with the tips rounded, or hardly truncate, not bidentate as in that species. The abdomen is broadly rounded at the apex.

23. A. apricans. *Buprestis apricans* Herbst, Käfer, 9, 125, tab. 145, fig. 9.
Buprestis Bosci Lap. & Gory, Mon. Buprest. 2, 146, tab. 36, fig. 201.

Southern States, rare. The tip of the abdomen is truncate and subsinuate in the male, broadly rounded in the female.

Cinyra Lap. (emend. Lac.)

1. C. gracilipes, elongata, obscure ænea, thorace latitudine vix breviore, punctato trisulcato, sulco medio latiore et profundo, elytris leviter striatis, punctatis, obsolete biimpressis, interstitiis alternis paulo elevatis, apice bidentatis. Long. .40—·44.

Mas tibiis anticis intus serratis.

Femina tibiis simplicibus.

Dicerca gracilipes Mels. Proc. Acad. Nat. Sc. 2, 145.

Pennsylvania to Wisconsin, rare. The head is punctured, with a smooth spot between the eyes: the lateral grooves of the thorax are less deep than the medial one, and the sides are perfectly straight. The body beneath is bright copper-coloured, densely and coarsely punctured on the trunk and sternum, more finely and less densely on the abdomen. The last ventral segment is a little more subtruncate in the female, and in both there is a little submarginal transverse elevated line.

2. C. erythropus, "viridi-ænea, thorace viridi-purpureo, elytris punctato-striatis, corpore subtus viridi-aurato, pedibus ferrugineis." Long. ·40.

Buprestis (*Cinyra*) *erythropus* Gory, Mon. Bupr. 4, 126, tab. 22, fig. 124.

Unknown to me: perhaps from tropical America. The characters are however so distinct by the colouring, that it will be readily recognised by the above diagnosis, should it occur in our territory. The characters given in the description of Gory, with the exception of colour, are those of the preceding species.

GROUP III.

While adhering very closely to the previous one by its general structure, this group is at the same time sufficiently marked to enable it to be readily distinguished. The chief characters separating it are: the small rounded or transverse scutellum, and the sharp pointed prosternum, with acute lateral angles behind the coxæ, as in Chrysobothris: the mesosternum is separate from the metasternum, and divided by a narrow fissure in which is fitted the acute tip of the prosternum. The antennal pores are terminal: the mentum is partly membranous in one genus, entirely corneous in the other. The tarsi are slender, but slightly lobed, and the ungues are entire.

Mentum antice coriaceum; prothorax basi sinuatus - - -	Melanophila.
Mentum totum corneum; prothorax basi truncatus - - -	Anthaxia.

Melanophila Esch.

Our moderately numerous species may be grouped as follows.

A. Thorax dense punctatus, callis nitidis ornatus - - - - - - Sp. 1.
B. Thorax haud callosus; corpus planiusculum, supra glabrum.
a. Corpus supra subtiliter punctatum - - - - - - Sp. 2—6.
b. Corpus fortius punctatum; thorax rugosus - - - - - Sp. 7—8.
C. Thorax haud callosus, corpus cylindricum, supra breviter pubescens. - - - Sp. 9.

A.

1. M. miranda. *Phænops mirandus* Lec. Proc. Acad. Nat. Sc. 7, 83.

Fort Union, New Mexico, collected by Major Sibley.

B.—a.

2. M. conspùta, atra, depressa, opaca, thorace tenuiter canaliculato, subtilius transversim rugoso, lateribus punctato et lineis elevatis aciculato, angulis posticis longius carinatis, elytris postice oblique angustatis, confertim granulato-punctatis, guttis utrinque quatuor obscure croceis ornatis; subtus æneo-nigra. Long. ·47.
Lec. Pac. R. R. Expl. and Surveys, Vol. 11, Ins. 47° Par. 44.

Northern California, collected by Mr. J. Child, and given me by Mr. Rathvon. Nearly of the form of M. longipes, but narrower: tips of elytra separately rounded, not acuminate: the spots are so arranged as to form with those of the opposite elytron a figure rounded anteriorly, with a straight posterior outline.

3. M. notata. *Apatura notata* Lap. & Gory, Mon. Buprest. 1, 4, tab. 1, fig. 5.
Melanophila luteosignata Ziegler, Proc. Acad. Nat. Sc. 2, 267.

Middle and Southern States. Varies very much in the size of the yellow spots, the lateral one is sometimes large and triangular, sometimes only represented by two small round spots: the posterior spot is also sometimes divided into two. The apex of the elytra is slightly acuminate.

4. M. longipes *Gory*, Mon. Buprest. 4, 75, tab. 13, fig. 74.
Buprestis longipes Say, Journ. Ac. Nat. Sc. 3, 164.
Apatura appendiculata ‡ Lap. & Gory, Mon. Buprest. 1, 8, tab. 2, fig. 14.
Buprestis (Oxypteris) appendiculata Kirby, Fauna Bor. Am. 160.
Melanophila immaculata Gory, Mon. Bupr. 4, 74, tab. 13, fig. 72.

Pennsylvania, Kansas, Lake Superior. Very closely related to the European M. appendiculata, but on comparison the thorax is less rounded on the sides, which are less sinuate posteriorly. As in that species the sculpture is very indistinct at the middle, and the small carina at the basal angles is nearly parallel with the margin. The elytra are more gradually narrowed behind, and the apex is rectilinearly attenuated from the suture while in M. appendiculata, the inner outline of the tip is concave, though not so much so as in the next species. The tip of the abdomen, as in the others of this group, is slightly emarginate, with the angles acute.

5. M. atropurpurea. *Buprestis atropurpurea* Say, Journ. Acad. Nat. Sc. 3, 160.

Texas and Kansas. Varies much in size, and although very similar to the preceding, it differs by the following characters. The punctuation of the middle of the thorax is distinct, the sides are more broadly rounded, and not at all sinuate behind: the basal carinæ are shorter and diverge rapidly from the margin: finally, the elytra are more suddenly narrowed behind, and the tips are concavely attenuated from the suture, and armed with a short but very acute spine, while in the preceding they are merely pointed.

6. M. opaca, atra opaca, thorace latitudine vix breviore, lateribus ante medium obtuse angulatis, postice haud sinuatis, angulis posticis obtusis carina brevi margini approximata, punctis versus medium fere obsoletis, canaliculato, ante scutellum foveato, elytris granulato-punctatis late impressis, postice sensim attenuatis, apicibus intus paulo concavis spina brevi armatis. Long. ·50.

One specimen, Georgia. Differs from both the preceding by the sides of the thorax being obtusely angulated before the middle, at the widest part: the elytra are as in M. appendiculata, that is to say with a short not very acute spine at the apex, which is concavely attenuated on the sutural side. From M. appendiculata it differs chiefly by the sides of the thorax falling obliquely on the base, thus making the posterior angles obtuse.

B.—b.

7. M. Drummondi, nigro-ænea, depressa, thorace latitudine sesqui breviore, lateribus rotundatis, subcanaliculato, postice ad medium et latera late foveato, disco rugis transversis subtilibus insculpto, lateribus punctatis et longitudinaliter rugosis, elytris rugose punctatis, obsolete tricostatis, guttis flavis quatuor sæpe deficientibus ornatis. Long. ·31—·40.

Buprestis (*Trachypteris*) *Drummondi* Kirby, Fauna Bor. Am. 159.

Apatura Drummondi Lap. & Gory, Mon. Buprest. 1, 3, tab. 1, fig. 3: Mann. Bull. Mosc. 1843, 236.

Melanophila guttulata ‡ Mann. Bull. Mosc. 1853, 221.

Oregon and Washington Territories, abundant, straying into California and Russian America. Closely allied to the next, which however differs by the thorax being much more coarsely rugous and with distinct punctures all over the surface, and by the elytra being entirely destitute of vestiges of three costæ. The Siberian M. guttulata on comparison is found to be different from both: the thorax is rugous as in M. Drummondi, but its whole surface is besides more densely and finely punctured than in the next species and the sides are also less rounded: the elytra are more densely punctured with hardly perceptible traces of costæ. Thus as in the preceding group the species of the other continent holds an intermediate place between two of our species.

All three vary greatly in the size and number of the spots, which are frequently entirely absent.

8. M. fulvoguttata, nigro-ænea, depressa, thorace latitudine sesqui breviore, lateribus rotundatis, tenuiter

canaliculato, postice foveato, minus dense sat fortiter punctato, minus subtiliter rugoso, (rugis mediis transversis, lateralibus longitudinalibus,) elytris rugose punctatis, guttis flavis quatuor sæpe deficientibus. Long. ·36—·48.

Buprestis fulvoguttata Harris, New Engl. Farmer, 1829, p. 2: Ins. Inj. Veg. 44.

Apatura octospilota Lap. & Gory, Mon. Buprest. 1, 4, tab. 1. fig. 6.

Apatura croceosignata Lap. & Gory, Mon. Buprest. 1, 5, tab. 1, fig. 4.

Apatura decolorata Lap. & Gory, Mon. Buprest. 1, 5, tab. 1, fig. 7.

Middle and Northern parts of the United States, very abundant at Lake Superior. The variations in size or absence of spots are sufficient to account for Laporte's synonyms. The tip of the abdomen is broadly rounded, and subtruncate.

C.

9. M. aeneola, ænea, elongata modice convexa, capite dense rugose punctato, thorace latitudine breviore, antrorsum paulo angustato, dense punctato, ante scutellum foveato, elytris dense rugose punctatis pube brevi pallida parce indutis, abdomine virescente, nitido parce punctulato. Long. ·18—·20.

Melsheimer, Proc. Nat. Sc. 2, 146.

Melanophila metallica Mels. Proc. Acad. Nat. Sc. 2, 146.

Middle and Southern States. This species differs from all the preceding ones by the tip of the abdomen having a small transverse elevated line very near the margin, as in Cinyra, the tip itself being slightly truncate.

Apatura caudata Lap. & Gory, Mon. Buprest. 1, 8; tab. 2, 13, does not belong to this genus; the figure represents a species of Dicerca, and the description is comparative with D. acuminata. It is probably identical with my Dicerca caudata.

Anthaxia Esch.

A. Elytra fortius granulata.

a. *Capite punctato breviter piloso.*

1. A. expansa, lata, depressa, atra, opaca, vix ænescens, thorace latitudine duplo breviore, lateribus valde rotundatis, reticulatim punctato, elytris thorace haud latioribus, confertim granulatis, fortius marginatis, parallelis, postice suboblique attenuatis et rotundatis. Long. ·28.

Lec. Pac. R. R. Expl., Vol. 11., Insects 47th Par. 44.

Oregon. Closely related to the three following, but distinguished by the granules of the elytra being less elevated, and by the sculpture of the thorax. The latter is twice as wide as its length, very much rounded on the sides, with all the angles rounded: the disc is very slightly convex at the middle, and becomes broadly concave at the sides; there are four very faint foveæ placed transversely, and a slight vestige of a dorsal channel: the surface is covered with very shallow punctures, forming the usual reticulation, but very faint, and almost obsolete each side before the middle. Front scarcely concave, hairy. Body beneath black, abdomen shining, feebly reticulate with punctures.

2. A. foveicollis, lata, depressa, atra, ænescens, thorace latitudine duplo breviore, lateribus valde rotundatis, reticulatim punctato, foveis quatuor magnis transversim positis impresso, elytris thorace haud latioribus, confertim fortius granulatis, fortius marginatis, parallelis, postice suboblique attenuatis et rotundatis. Long. ·26.

Sacramento valley, Mr. Rathvon. Only differs from A. expansa by the thorax having the foveæ deep instead of obsolete, and by the punctures being a little stronger, both on the thorax and elytra: the front is hairy, and concave, but less deeply than in the next species.

3. A. strigata, lata depressa nigro-ænea, sæpe cyaneo-variegata, thorace latitudine fere duplo breviore, lateribus rotundatis, angulis posticis subrectis fortius reticulatim punctato, utrinque pone medium oblique impresso, elytris thorace haud latioribus confertim fortius granulatis, fortius marginatis, parallelis postice suboblique attenuatis et rotundatis. Long. ·17—·25.

?*Anthaxia æneogaster* Lap. & Gory, Mon. Bupr. 2, 32; tab. 7, fig. 44.

Fort Tejon, California; Mr. Xantus. Front moderately concave, hairy. The sides of the thorax are less rounded than in the two preceding; there are no foveæ, but on each side behind the middle a strong oblique impression running inwards towards the base: the punctures are strongly marked, and there are besides fine elevated lines, having a general longitudinal direction, connected together, forming elongate meshes: the disc is feebly channeled behind the middle. Body beneath greenish, abdomen shining, reticulate with punctures. In some specimens the disc of the thorax is darker than the sides. This is perhaps A. æneogaster *Lap. & Gory*, but the description gives no definite characters by which to separate it from allied species.

4. A. imperfecta, latiuscula, depressa, nigro-ænea, thorace latitudine duplo breviore, antrorsum angustiore, lateribus rotundatis, angulis posticis obtusis, reticulatim punctato, valde quadrifoveato, postice versus medium strigis elevatis haud connexis, elytris granulatis, fortius marginatis, parallelis postice angustatis et rotundatis. Long. ·24.

One specimen collected at Santa Fe, New Mexico, by Mr. Fendler. The sides of the thorax are more broadly rounded, especially before the middle, producing thereby the appearance that the thorax is more narrowed in front, than in the preceding species: the sculpture is singular, the ordinary reticulation is not strong, and behind, towards the middle, is broken up into undulating elevated lines having a general transverse direction, and not connected. The front is hairy, scarcely concave.

5. A. retifer, latiuscula, depressa, nigro-ænea, thorace latitudine duplo breviore, antrorsum angustiore, lateribus late rotundatis, angulis posticis obtusis, fortius reticulatim punctato, obsolete quadrifoveato, elytris granulatis, fortius marginatis, parallelis, postice angustatis et rotundatis. Long. ·22.

One specimen with the preceding. Differs from A. imperfecta by the faint foveæ of the thorax, and by the reticulation being strong and regular over the whole disc. These two differ very much in the same manner as A. expansa and foveicollis, and

I should be inclined to consider the differences as sexual, but that I have before me a large series of A. strigata in which no such variations are seen.

b. *Capite glabro, reticulato.*

6. A. inornata, latiuscula, depressa, nigro-ænea, thorace latitudine plus duplo breviore, postice paulo angustato, lateribus rotundatis, postice subsinuatis, et marginatis fortius reticulatim punctato, subgranulato profunde quadrifoveato, elytris dense rugose granulatis, fortius marginatis, parallelis postice angustatis et rotundatis. Long. ·23.

Buprestis inornata Randall, Bost. Journ. of Nat. His. 2, 4.

One specimen from New York given me by Mr. John Akhurst. This species resembles in appearance A. foveicollis, but is broader and smaller, with the thorax densely and strongly reticulated. It also differs from all the preceding species by the head being entirely glabrous, with the punctures more closely placed, and forming a reticulate surface: the central portion of these punctures both of the head and thorax is elevated, so that an appearance is produced intermediate between reticulation and granulation. According to Randall the impressions of the thorax are sometimes obsolete.

B. Elytra subtiliter rugosa, vix obsolete granulata.

7. A. cyanella, cyanea, vel purpurea, capite fortiter reticulato, thorace latitudine sesqui breviore, antrorsum subangustato, lateribus late rotundatis, reticulato, pone medium utrinque transversim oblique profunde impresso, elytris parallelis postice oblique rotundatis, subtiliter rugosis. Long. ·17—·21.

Gory, Mon. Buprest. 4, 285; tab. 47, fig. 278.

Anthaxia scoriacea Mels. Proc. Acad. Nat. Sc. 2, 148.

Middle, Southern and Western States, rare. Of precisely the same form as the next, and differing only by the colour, and by the surface of the meshes of the net-work covering the thorax being nearly smooth. The oblique impressions of the thorax are formed by the confluence of the two transverse ones; the anterior and interior of which nearly meet at the middle. The front is sometimes green.

8. A. subænea, nigro-ænea, opaca, elytris interdum cyanescentibus, capite thoraceque fortiter reticulatis, hoc subtiliter granulato, latitudine sesqui breviore, lateribus late rotundatis, pone medium utrinque oblique impresso, elytris parallelis postice oblique rotundatis, subtiliter rugosis, antennis viridiæneis. Long. ·20—·25.

Anthaxia viridicornis ‡ Lap. & Gory, Mon. Bupr. 2, 19; tab. 5, fig. 25.

Abundant in the Middle and Western States. Under the specific name quoted, Say has confounded several different insects, but in neither place where he uses it, is reference made to the form here under consideration.

9. A. viridicornis cyaneo-nigra, opaca, fronte thoracisque lateribus fulgenti-cupreis, fortiter reticulatis, hoc subtiliter granulato, latitudine sesqui breviore, lateribus rotundatis, utrinque transversim impresso, elytris parallelis postice oblique rotundatis, subtiliter rugosis, antennis nigro-viridibus. Long. ·20—·27.

Buprestis viridicornis var. Say, Trans. Am. Phil. Soc. 4, 161.

Maryland, Mr. J. Ph. Wild. The sculpture is precisely that of the preceding, but the thorax is a little wider, and the impressions, (formed as usual of two on each side,) do not reach the base or posterior angles, but run to the sides; the posterior angles are also more obtuse. The head is bright coppery, with the occiput and sometimes a small frontal spot black.

The type B. viridicornis *Say*, (Journ. Acad. Nat. Sc. 3, 163,) inhabits Missouri, and is described as having the head and thorax bright coppery, and the antennæ green; body beneath brassy. It is probably a variety of the one here described. Of my specimens two are entirely blue black beneath, while the third is brassy; the elytra of the last mentioned specimen are black bronzed.

10. A. viridifrons, fusco-ænea, opaca, capite læte viridiæneo, fortiter reticulato, thorace latitudine plus sesqui breviore, lateribus late rotundatis sæpe viridibus, reticulato, utrinque transversim impresso, elytris a basi vix angustatis postice oblique rotundatis, subtiliter rugosis. Long. ·18—·20.

Gory, Mon. Buprest, 4, 284; tab. 47, fig. 277.

Middle and Western States. At first view resembles A. subænea, but on comparison, the thorax is found less rounded on the sides, the basal angles more rectangular, and the head more deeply punctured. The elytra are also slightly narrowed from the base, thus forming a transition to the following species.

11. A. quercata, opaca, capite fusco, macula annulari conchoidea viridiænea, fortiter reticulato, thorace latitudine sesqui breviore, postice subangustato, lateribus late rotundatis olivaceis, reticulato, utrinque pone medium transversim impresso, vitta dorsali latissima fusca, elytris fere parallelis, postice oblique rotundatis, subtiliter rugosis, olivaceis, margine vittaque obliqua integra suturam ad medium attingente fuscis; subtus viridi-nigra, abdominis margine laterali viridiaureo. Long. ·16—·23.

Variat tota viridi-nigra, abdominis lateribus solis viridiæneis.

Lap. & Gory, Mon. Buprest. 2, 21; tab. 5, fig. 28.

Buprestis quercata Fabr. Syst. El. 2, 216.

Buprestis viridicornis ‡ var. Say, Trans. Am. Phil. Soc. 4, 161.

Middle and Southern States, abundant. Varies in colour and size, but appears to be always a little broader than the next species, with the sides of the thorax a little more rounded and the elytra less distinctly narrowed from the base.

12. A. cuneiformis, opaca, capite viridiæneo, fortiter reticulato, thorace latitudine sesqui breviore, postice subangustato, lateribus antice paulo rotundatis viridibus, vitta dorsali fusca sæpe obsoleta, reticulato, postice utrinque transversim impresso, elytris a basi sensim angustatis, apice oblique rotundatis, viridibus margine et sutura pone medium fuscescentibus, subtiliter rugosis; subtus viridi-nigra, abdominis margine laterali parapleurisque viridiæneis. Long. ·15—·23.

Gory, Mon. Buprest. 4, 290; tab. 48, fig. 284.

Southern and Western States. I am very doubtful whether this should be regarded as

more than a race of the preceding species, from which it differs only by the characters above noted, and by the head being entirely brassy green, and perhaps a little more deeply reticulated.

13. A. flavimana, linearis nigra, opaca, subcyanescens, capite thoracisque lateribus sæpe viridibus, illo fortius, hoc modice reticulato, latitudine parum breviore, postice angustato, lateribus antice parum angustatis, disco bifoveato, ante basin utrinque transversim impresso, basi medio foveato, elytris a basi angustatis, apice rotundatis, subtiliter rugosis, vage punctatis substriatis, interstitio discoideo magis elevato; subtus obscure viridis, tarsis anticis flavis vel piceis. Lon. ·14—·18.

Gory, Mon. Buprest. 4, 291; tab. 49, 285.

Anthaxia gracilis Mels. Proc. Acad. Nat. Sc. Phil. 2, 148.

Southern States. Varies somewhat in colour: some of the specimens are of a fuscous black above, with the head, sides of the thorax, and suture of the elytra dark green; in these the tarsi are piceous. In others, the head and sides of the thorax are of a moderately bright green, the disc of the thorax fuscous, and the elytra very dark blackish blue, the under surface is green, and the anterior tarsi yellow. These are the two extremes, but intermediate forms occur, all agreeing in the vaguely punctured and feebly striate elytra.

14. A. bivittata "supra viridi-obscura, elongata; thorace elytrisque vittis duabus purpureis, corpore infra viridi." Long. ·16.

Gory, Mon. Buprest. 4, 292; tab. 49, 286.

Unknown to me. Seems closely to resemble the preceding in form, but the elytra are described as being sculptured in a squamiform manner.

GROUP IV.

We have the regular progression of forms here interrupted by a number of genera which are distinguished by the prosternum being very broad and obtuse, fitting into the emarginate mesosternum, which is frequently entirely connate with the metasternum; sometimes, as in a few species of Acmæodera, the mesosternum is divided, but in such case the form of the prosternum readily distinguishes this from the two preceding groups.

The suture between the first and segments of the abdomen, is distinct in Polycesta, obsolete in the other genera. The mentum is entirely corneous. The ungues are usually simple, but in Acmæodera and Ptosima they are appendiculate. Our genera may be grouped:

A. Unguiculi simplices, (scutellum distinctum.)

Tarsi postici articulo 1mo haud elongato - - - - -	Thrincopyge.
Tarsi postici articulo 1mo longiore.	
Mandibulæ obtusæ - - - - - -	Chrysophana.
Mandibulæ acutæ - - - - - -	Polycesta.

B. Unguiculi appendiculati.

Parapleuræ obtectæ (scutellum distinctum.) - - - - -	Ptosima.
Parapleuræ detectæ (scutellum nullum.) - - - - -	Acmæodera.

Thrincopyge Lec.

Antennæ distantes, in foveis minutis insertæ, articulo 1mo longiore sed haud crassiore, 2—4 obconicis, 5—6 triangularibus, 7—11 subtrapezoideis: fossulis poriferis infernis, inconspicuis. Labrum transversum; epistoma late emarginatum. Mandibulæ truncatæ, valde obtusæ. Palpi breves filiformes. Mentum breve, corneum, trapezoideum. Scutellum parvum triangulare. Prosternum latum lateribus haud angulatis, apice valde obtusum; mesosternum emarginatum, haud divisum, metasterno arcte conuatum, sutura tamen distincta. Pedes breves, tarsi valde dilatati subtus lobati, articulo ultimo plano, unguiculis distantibus integris, 1mo posticorum paulo longiore. Abdomen sexus utriusque articulo 5to postice sulco profunde circumducto.

A curious genus containing New Mexican species. The body is flat above, narrow and subparallel, the thorax narrower at the base, rounded on the sides, base bisinuate and margined. Elytra with acute humeral angles, parallel on the sides, then narrowed to the apex which is truncate and finely serrate. Anal plate in male formed of two segments, the last slightly emarginate; in the female flat and broadly rounded.

1. T. alacris, læte viridi vel cyaneo-ænea, nitida, capite grosse thorace parcius punctato, lateribus flavo marginatis, elytris punctato-striatis, interstitiis parce punctulatis, maculis utrinque tribus plus minusve deficientibus, apice truncato subtiliter serrato. Long. ·65—·8. Tab. XII., fig. 2.

Lec. Journ. Acad. Nat. Sc. 2nd ser. 4, 17.

Arizona and New Mexico. Varies in the size of the spots of the elytra, which become smaller, interrupted, and finally disappear entirely. The lateral yellow margin of the thorax also disappears, leaving only a spot behind the middle. In one specimen the anterior margin is also yellow and interrupted into spots. A yellow spot on the posterior coxæ is usually seen, but fails in many specimens; so, too, with a yellow dot at the anterior extremities of the anal sulcus.

2. T. ambiens, viridi-ænea, capite dense punctato, fronte rugosa, thorace punctato, margine laterali flavo, elytris striatis, striis punctatis, interstitiis uniseriatim punctatis, margine laterali flavo, pone humeros et ad medium paulo latiore. Long. ·68.

Buprestis ambiens Lec. Proc. Acad. 7, 83.

One specimen, Frontera, Rio Grande, Mr. Clarke. Of a brighter green than the preceding, though much less shining.

Chrysophana Lec.

Antennæ distantes, in foveis parvis insertæ, tenues, articulo 1mo obconico, et 2ndo paulo crassioribus, hoc duplo breviore, 3io angusto 1mo æquali, 4—10 triangularibus, parce pilosis, sensim vix brevioribus, ultimo ovali, (fossulis poriferis haud obviis.) Labrum integrum, epistoma late emarginatum. Mandibulæ subacutæ; palpi fili-

formes; mentum trapezoideum corneum. Scutellum minutum rotundatum. Prosternum breve latum, postice obtuse rotundatum; mesosternum planum emarginatum haud divisum, cum metasterno apice truncato, haud connatum. Abdomen articulis duobus primis connatis, sutura vix distincta. Tarsi articulis 3 et 4 lobatis, antici dilatati, postici articulo 1mo elongato, ultimo angusto, unguiculis simplicibus.

A small species having very nearly the colour, form and sculpture of Ancylochira decora. The body is elongate, narrowed at each end, and convex. The thorax broadly rounded on the sides, truncate in front, nearly so behind. Elytra rounded behind, not serrate.

1. C. placida, viridi-ænea, undique dense punctata, thorace medio cupreo-micante, elytris striis parum impressis, vittaque discoidali cuprea ornatis. Long. ·3.

One specimen collected in Oregon by Dr. J. K. Townsend, was given me by Mr. Willcox, as *Phœnops placida* of the Berlin Museum. It is, however, not at all related to that genus either in appearance or character.

Polycesta Sol.

1. P. elata Lec. Proc. Acad. 1858, 68.

Texas, Mr. H. Haldeman.

2. P. cavata, nigra subænea, fronte concava, thorace tri-excavato medio subcarinato, elytris valde costatis, rude clathratis, interstitiis (costis exceptis) suturaque parce punctatis. Long. ·7.

Lec. Proc. Acad. Nat. Sc. 1858, 68.

Alabama, given me by Prof. Haldeman. Black, slightly bronzed. Head very coarsely punctured, front deeply concave. Thorax three times as wide as long, angulated on the sides at the middle, where it is broadest, rapidly narrowed to the apex, and slightly to the base: covered with very large punctures, unequally distributed, leaving the spaces between the three large excavations very sparsely punctured; there is besides a small callus at the apex near each angle: the middle excavation is subcarinate. Elytra strongly costate, the intervals between the costæ with two series of very large quadrate punctures, the interstices sparsely punctured, sutural costa with a series of punctures: second and third costæ smooth; they are parallel on the sides for two thirds their length, then obliquely narrowed, and irregularly serrate to the apex, which is slightly rounded.

3. P. californica, nigra, subænea, fronte parum concava, thorace tri-excavato, elytris valde costatis, modice clathratis, interstitiis (costis exceptis) dense punctatis. Long. ·75.

Lec. Pacific R. R. Expl. & Surveys, Ins. 47th Par. 45: Proc. Acad. 1858, 68.

Sacramento, California, collected by Mr. Wittick and given me by Mr. S. S. Rathvon.

4. P. obtusa, nigra subænea, fronte plana, thorace planiusculo, medio postice foveato, elytris postice obtuse rotundatis, seriatim variolatis, interstitiis parce punctulatis, 3io antice latiore. Long. ·48.

Lec. Proc. Acad. Nat. Sc. 1858, 68.

A specimen found in Philadelphia, was kindly given me by Mr. George Newman. Smaller than the others. Head coarsely punctured, front not concave; thorax more than twice as wide as long, strongly angulated on the sides, narrowed to the base, but more narrowed to the apex; coarsely and equally punctured, disc flattened towards the middle, with a large oblong fovea at the middle of the base. Elytra parallel on the sides, obtusely rounded and serrate at the tip; striate with rows of square punctures, the interstices finely sparsely punctured, the 3d growing gradually wider and more elevated towards the base. The subsutural row of punctures forks near the base, leaving a short interval.

5. P. velasco, nigro-æenea, fronte plana, thorace planiusculo, postice subfoveato, et subtiliter canaliculato, disco antice utrinque late impresso, elytris seriatim grosse punctatis, interstitiis parce punctatis, alternatim elatioribus. Long. ·77.

Laporte & Gory, Mon. Buprest, 2, 6, tab. 1, fig. 7.

A Mexican species, but found by Mr. Arthur Schott on the Rio Grande in Texas. Body black bronzed. Head coarsely punctured, front flat, with a slight medial elevated line. Thorax nearly three times as wide as long, obtusely rounded on the sides at the middle, narrowed to the base, but more so to the apex, coarsely punctured, densely at the sides, not densely at the middle, slightly broadly impressed at the middle of the base, and with two faint rounded impressions before the middle: a fine impressed dorsal line extends from the middle to the base. Elytra slightly narrowed from the base to three-fourths of the length, then obliquely narrowed to the apex, which is rounded; with striæ of large punctures, the interstices finely punctured, alternately a little more elevated, sutural costa bifurcated a little before the middle, thus forming a long and broad scutellar costa.

Ptosima, Sol.

1. P. luctuosa Gory Mon. Buprest. 4, 71, tab. 13, f. 69.
Buprestis gibbicollis || Say, Journ. Acad. Nat. Sc. Phil. 3, 161.

Alabama, Ohio, Missouri: Say stated (Trans. Am. Phil. Soc. 6, 158) that the name given by him was preoccupied for a European species, and ought to be changed, but neglected to propose another. I am, therefore, under the necessity of adopting the more recent name of Gory. Erichson, by a singular error, mentions this species (Bericht, &c., 1840, 19) as belonging to Acmæodera.

Acmæodera Esch.

Though but few species of this genus are found within the old limits of the United States, the extension of our territory towards the South and West, has introduced into our fauna a considerable number, of which several extend into Mexico, and were previously described from that country; probably others of the species described by me, may

be found identical with Mexican species, but, if so, I can only plead the insufficiency of previous descriptions, or the inaccuracy of figures, as an excuse for any synonyms I may make.

Our species may be conveniently arranged as follows.

I. *Abdomen segmento ventrali ultimo cristula transversa munito et sulco circumducto.*

A. Cuneiformes, thorace ante basin latiore, lateribus valde rotundatis, medio late excavato, ad latera oblique impresso, elytris striatis; corpus subtus parum pubescens - - - - - Sp. 1–6.

B. Cuneiformis, elongata, thorace lateribus postice subrectis parallelis, elytris costatis; corpus subtus longe pilosum - - - - - - - - - - - Sp. 7.

C. Fusiformis, thorace lateribus obliquis, subrectis, elytris striatis, humeris valde prolongatis, lateribus fortius sinuatis; corpus subtus longe pilosum - - - - - - Sp. 8.

D. Vix cuneiformes, sæpe cylindrici, thorace lateribus late rotundatis, angulis posticis subrectis, elytris striatis; corpus subtus parum pubescens. - - - - - - - - Sp. 9–13.

II. *Abdomen segmento ventrali ultimo simplici.*

E. Subcylindricæ, elytris striatis; corpus subtus parum pubescens. - - - - Sp. 14–15.

F. Cylindrica, elytris striatis; corpus subtus longe pilosum. - - - - Sp. 16.

A.

1. A. flavomarginata, cuneiformis, supra æneo-nigra, pilis nigris erectis pilosa, fronte concava, thorace latitudine plus duplo breviore, lateribus valde rotundatis fortius marginatis ante basin latiore, fortiter punctato, medio triangulariter late et profunde excavato, utrinque oblique impresso, vitta marginali flava ornato; elytris punctis magnis seriatis fortiter impressis, interstitiis angustis uniseriatim punctulatis, a basi sensim angustatis, margine incrassato, dorso deplanatis, postice valde serratis singulatim rotundatis, vitta marginali postice abbreviata flava, fasciaque miniata antea picali, guttam communem suturalem alteramque lateralem nigras includente; subtus nigro-ænea, parce cinereo-pubescens. Long. ·43.

Gory in Griffith's An. Kingdom, 1, 358, pl. 31, fig. 2; Chevr. Col. Mex. cent. 1ma. Lap. & Gory, Mon. Buprest. 1, 2, tab. 1, fig. 2.

Eagle Pass, Rio Grande, Texas, Mr. A. Schott; abundant in Mexico. A very small yellow sutural spot near the apex of the elytra is visible in one specimen; in another, the lateral yellow stripe includes a marginal black dot near its termination. The red tint of the posterior band is sometimes wanting. The striæ at the sides and tip are very deep, so that the intervals become convex. The 3d and 5th intervals are slightly elevated at the base. The last ventral segment has a broad shallow marginal groove, with a faint transverse carina near the apex.

2. A. opacula, cuneiformis, æneo-nigra, hirta, fronte vix impressa, thorace latitudine plus duplo breviore, lateribus obliquis rotundatis, fortiter marginatis, ante basin latiore, rude punctato, minus dense in medio, triangulariter late excavato, versus latera late foveato, lateribus flavis, margine summo nigro-æneo, elytris thorace angustioribus, a basi angustatis, postice magis attenuatis fortiter serratis singulatim subrotundatis, punctis quadratis seriatis, striis externis et ad apicem profundis, interstitiis angustis uniseriatim punctulatis, maculis pluribus saturate flavis, posticis rufo-tinctis; subtus parce pubescens. Long. ·42. Tab. XII. fig. 3.

Le Conte, Proc. Acad. Nat. Sc. Phila., 1858, 69.

One specimen, El Paso, Rio Grande, Mr. Clark. Differs from all the following species of this division by the more strongly margined sides of the thorax. The spaces between the rows of punctures of the elytra are unusually narrow; the spots are a marginal elongate one near the humerus, another larger marginal about the middle, which includes a black spot; a basal dot on the 3d interval, two spots before the middle extending from the second and the fifth stria; then two smaller ones, the position of which is nearer the suture; finally, two transverse oblique one, reaching the margin, and a subapical dot. The last ventral segment has barely a trace of the subapical carina, but the marginal groove is deep.

3. A. hæmorrhoa, cuneiformis, elongata, nigro-ænea, pilis nigris erectis hispida, fronte concava, cinereo-pilosa, thorace latitudine plus duplo breviore, lateribus rotundatis, ante basin paulo latiore, fortiter punctato, medio triangulariter valde excavato, et canaliculato utrinque oblique profunde excavato, gutta marginali flava ornato; elytris punctis magnis seriatis, striis externis et ad apicem impressis, interstitiis uniseriatim punctulatis, a basi sensim angustatis, dorso deplanatis, postice valde serratis, conjunctim rotundatis, violaceo-nigris maculis parvis confluentibus flavis variegatis, margine apicali late minio; subtus nigro-ænea parce cinereo-pubescens. Long. ·40—·45. Tab. XII., fig. 4.

Le Conte, Proc. Acad. Nat. Sc. Phila., 1858, 69.

Texas and Northern Mexico, Mr. Schott. This species has nearly the same outline as the preceding; the elytra of the female are less regularly attenuated, and are more rounded on the sides. The last ventral segment has a transverse prominent carina, or rather a short plate near the apex, and shallow marginal groove.

There is nothing in either the figure or description of A. stellaris as given by Gory, Mon. Buprest. 4, 28, tab. 5, f. 25, which would forbid the reference of the present species to it, except that the scarlet apical margin of the elytra is not mentioned. This is probably an inconstant character, but the more full descriptions of Chevrolat and Spinola, show that A. stellaris is very different from the species now under consideration, and probably belongs to group D.

4. A. connexa, cuneiformis, depressa, nigro-ænea, hirta, thorace latitudine triplo breviore, lateribus rotundatis postice subito incurvis, ad basin elytris latiore, rude punctato, medio triangulariter late excavato postice utrinque oblique foveato; elytris punctis quadratis profundis, striis postice et extrorsum magis impressis, interstitiis uniseriatim punctulatis; a basi sensim, postice magis angustatis et fortiter serratis, apice conjunctim rotundatis, maculis pluribus ante medium varie confluentibus, pone medium fasciis duabus flavis ornatis; subtus parce cinereo-pubescens. Long. ·35—·47.

Le Conte, Proc. Acad. Nat. Sc. Phila. 1859, 72.

Fort Tejon, California: John Xantus, Esq. More depressed than our other species, and readily distinguished by the characters above given. In addition, it may be observed, that the front is not concave, and the last ventral segment is broadly margined as usual.

In the male the apex is truncate, with a submarginal transverse carina; in the female it is rounded, and the carina is less distinct. The spots are very variable; in one specimen the anterior ones are small and not connected with a transverse band-like spot at the middle: in others, there is a vitta from the base to the middle, enclosing several spots, and bending outwards to the margin at its extremity. The posterior bands are oblique, and do not attain the suture; a minute apical yellow dot is frequently seen.

The wings of several specimens project when the elytra are closed, from which I am disposed to think, that this species flies after the manner of Cetoniæ, with the elytra not expanded.

5. A. acuta, cuneiformis, depressa, nigro-ænea, hirta, thorace latitudine plus duplo breviore, lateribus rotundatis, ante basin vix latiore, grosse punctato medio triangulariter valde excavato, ad latera oblique excavato, elytris thorace haud angustioribus, a basi sensim attenuatis, postice magis oblique attenuatis, et serratis apice conjunctim rotundatis, punctis seriatis impressis, striis externis profundis, interstitiis planis rugulosis, uniseriatim punctulatis, maculis pluribus ante medium confluentibus, alterisque duabus pone medium, prima transversa, secunda longitudinali; subtus parce cinereo-pubescens. Long. ·33.

One specimen with the preceding, from Fort Tejon. Resembles the former in markings, but the form is quite different, the thorax being not wider than the elytra, with the sides not inflexed behind; it is more coarsely punctured, and the disc is more excavated: the elytra are attenuated, and therefore more acute behind: the anterior spots have a tendency to become confluent, but the two which represent the posterior bands are different, one being a marginal transverse spot, and the other a subapical longitudinal one: there is, besides, an apical yellow dot, and a minute marginal one. The last ventral segment is rounded, with a small subapical carina.

6. A. ornata, subcuneiformis, atra, hirta, fronte parum impressa, thorace latitudine duplo breviore, lateribus rotundatis, ad basin subito incurvis, fortiter punctato in medio postice, et versus latera late et profunde excavato, gutta marginali flava sæpe ornato, elytris cyaneo-nigris, punctis magnis seriatis, striis externis et ad apicem impressis, interstitiis angustis, uniseriatim punctulatis, a basi ad dodrantem subangustatis, dein magis attenuatis et fortiter serratis, apice conjunctim rotundatis, dorso deplanatis maculis parvis pluribus flavis ornatis; subtus cyanescens, nitida, parce cinereo-pubescens. Long. ·30—·44.

Laporte et Gory, Mon. Buprest. 1, 6; tab. 2, fig. 7.

Buprestis ornata Fabr. Ent. Syst. 1, 2, 200: Syst. El. 2, 199. Herbst, Col. 9, 209, tab. 154, fig. 5: Say, Trans. Am. Phil. Soc. 6, 159.

From Massachusetts to Texas, not rare. For a more full list of references see Laporte & Gory, loc. cit. The front is sometimes slightly impressed, sometimes not at all so: the elytra are a little more rounded on the sides in the female than in the male. The last ventral segment is margined as usual, and the subapical carina is distinct, but more prominent in the male than in the female; the apex is also subtruncate in the former. The spots vary in number, but are always small and irregular.

B.

7. A. comata, cuneiformis, valde elongata, nigra subænea, pilis longis lanuginosis albis parce vestita, fronte late concava, capite thoraceque grosse punctatis, hoc latitudine sesqui breviore, lateribus parallelis antice paulo rotundatis, apice late marginato, medio longitudinaliter haud profunde excavato, ad basin utrinque breviter oblique excavato, elytris a basi sensim, postice autem magis attenuatis et serratis, crenato-striatis, interstitiis alternis elevatis, punctis paucis parvis flavis ornatis; subtus præcipue ad latera longe albo-pubescens. Long. ·38. Tab. XII., fig. 5.

Le Conte, Proc. Acad. Nat. Sc. Philad. 1858, 70.

One specimen found on the Colorado river, below the Gila. The punctures of the under surface are less deep at the middle of the anterior segments of the abdomen; the last ventral segment has no subapical carina, but the groove is distinct. The two outer striæ of the elytra are confluent behind the humerus.

C.

8. A. gibbula, nigro-ænea, supra parce albo-pilosa, capite subtilius, thorace sat dense punctato, hoc latitudine baseos duplo breviore, lateribus obliquis parum rotundatis, antrorsum valde angusta, medio triangulariter excavato, basi utrinque profunde foveato; elytris humeris valde callosis, angulo producto, thoracis basin amplectente, punctis quadratis seriatis, striis externis et ad apicem profundis, 1ma antice fere obliterata, interstitiis uniseriatim punctulatis, nigro-cyaneis, maculis pluribus magnis flavis ornatis, posticis rufotinctis; subtus longe dense albo-pubescens, vitta media subglabra. Long. ·5. Tab. XII., fig. 6.

Le Conte, Proc. Acad. Nat. Sc. Philad. 1858, 69.

Two specimens found by Dr. T. H. Webb on a journey from El Paso to San Diego. The front is very slightly impressed: the sides of the elytra, from the prolongation of the humeral angles, are deeply sinuate near the base; their outline in the male is somewhat cuneiform, narrowing in a slight curve from the base, they are strongly serrate behind, and the tip is conjointly rounded: in the female they are nearly parallel, and slightly sinuate for three-fourths the length, then obliquely narrowed to the apex. The spots of the disc are seven or eight in number, forming a series on the 3d, 4th and 5th intervals, and are unequal in size: the other spots are, a humeral dot, three marginal spots occupying two intervals, and finally three spots alternate with the marginal ones, on the 3d interval from the side; these last are tinged with scarlet: the two outer striæ are confluent anteriorly. The punctures of the under surface are more sparse, but not smaller at the middle than at the sides: the last ventral segment has a very broad carina and the usual groove.

D.

9. A. pulchella, supra violaceo-ænea, nitida, hirta, thorace latitudine plus duplo breviore, lateribus late rotundatis, ante basin haud latiore, sat dense punctato, ad basin trifoveato, fovea media majore haud profunda, macula parva flava utrinque ad angulum sæpe ornato; elytris striis punctatis postice et extrorsum impressis, interstitiis uniseriatim punctatis, macula magna laterali postice latiore, fasciis duabus posticis flavis, (guttisque pluribus posticis sæpe ornatis,) postice valde serratis, apice conjunctim rotundatis; subtus nigro-ænea, parce punctata, parum pubescens. Long. ·28—·40.

Mas subcuneiformis, elytris a basi ad dodrantem subangustatis, dein magis attenuatis: segmento ventrali ultimo postice marginato, linea submarginali paulo elevata.

Femina subcylindrica, elytris a basi haud angustatis, postico subito angustatis, segmento ventrali ultimo postice marginato, linea submarginali breviore magis elevata.

Buprestis pulchella Herbst. Col. 9, 211; tab. 154, f. 6. (1801.) Say, Trans. Am. Phil. Soc. 6, 158.

? Buprestis ornata ‡ Oliv. Ins. 32, 50, tab. 7, fig. 7. (icon pess. vix spec. Fabr.)

Acmæodera ornata Spinola, Ann. Ent. Soc. France, 7, 365.

Acmæodera volvulus ‡ Lap. & Gory, Mon. Bupr. 1, 7, tab. 2, f. 8. (nec. Fabr.)

Acmæodera flavosignata Gory, Mon. Bupr. 4, 30, tab. 6, f. 28.

? Acmæodera dispar Gory, Mon. Bupr. 4, 31, tab. 6, f. 29.

Middle, Southern, and Western States, not rare. Messrs. Laporte and Gory have not only applied to this species the description of Fabricius, which does not at all agree with it, but have repeated in the synonymy references to Olivier, which had been previously cited under A. ornata. This species varies greatly in its elytral markings, and sometimes in addition to those mentioned in the diagnosis there is a narrow interrupted subsutural yellow vitta. The description of Olivier seems to refer rather to this species, than to the one above described as A. ornata, but is still somewhat doubtful.

10. A. variegata, nigro-ænea, hirta, sub-cuneiformis, thorace latitudine plus duplo latiore, lateribus late rotundatis, ante basin sublatiore, sat dense punctato, ad basin medio late depresso, et foveato, utrinque oblique modice impresso, foveaque profunda notato, macula laterali fulva; elytris striis grosse punctatis, postice et extrorsum impressis, interstitiis uniseriatim punctatis, maculis basalibus humerum ambientibus, fasciisque transversis margine confluentibus ad suturam interruptis fulvis, postice valde serratis, apice conjunctim rotundatis; subtus fortiter punctata, parce pubescens. Long. ·30—·35.

Lec. Proc. Acad. Nat. Sc. Phila. 6, 67, (in part.)

Sante Fe, New Mexico, Mr. Fendler; Texas, Mr. Haldeman. Liable to be confounded with some of the varieties of the next species, but on comparison the thorax is more depressed at the middle of the base, and the lateral foveæ are larger and accompanied with faint oblique impressions; the sides of the thorax are much more rounded, less declivous, and the posterior angles are almost obtuse: the elytra are also more flattened towards the base, whereby the humeral bullæ become more protuberant, the sides converge very slightly from the base, and are obliquely narrowed for the posterior fourth: on this account the shape becomes slightly cuneiform. The markings of the elytra are reddish yellow; confluent spots surround the humerus; a broad band, more or less irregular at the middle, another at about three-fifths the length, and a fourth half way between the last and tip, extending along the margin to the tip; these bands are in some specimens connected along the margin, where they include a few small black spots; the two external striæ unite and are abbreviated behind the humerus.

The last segment of the abdomen, as usual is margined, with a small transverse subapical crest, alike in the three specimens before me.

11. A. mixta, subcylindrica (mas vix cuneiformis, femina fere obesa) obscure ænea, hirta, thorace latitudine duplo breviore, lateribus antice oblique rotundatis, postice parallelis, sat dense punctato, basi medio minus late foveato, punctoque utrinque versus latera impresso, macula laterali fulva; elytris striis punctatis, postice et extrorsum impressis, interstitiis uniseriatim punctatis; fasciis præcipue anticis plus minus confluentibus, guttis parvis nigris sæpe solis relictis, postice serratis, conjunctim rotundatis; subtus fortiter punctata, parce pubescens. Long. ·30—·50.

Mas, elytris postice magis oblique attenuatis, abdominis segmento ventrali ultimo carinula subapicali transversa longiore.

Femina, elytris postice magis rotundatim attenuatis, abdominis segmento ventrali ultimo carinula transversa brevi.

Acmæodera variegata Lec. Proc. Acad. Nat. Sc. Phila. 6, 67, (in part.)

Texas, New Mexico, Kansas; Mr. Lindheimer, Capt. Pope, Mr. Xantus. The differences between this and the preceding have been already pointed out: it only remains to add, that the markings of the elytra vary very much: normally they consist of four bands and an apical dot, the first surrounds the humeral bulla; these bands then become confluent on the margin, enclosing a few black marginal spots, and the first and second coalesce on the disc, including a large irregular spot: finally all the bands become confluent, so that the elytra are reddish yellow, with the suture green bronzed, the humeral bullæ, and some small dots especially behind the middle alone remaining black.

12. A. semivittata, subcuneiformis, minus elongata, æneo-nigra, nitida, hirta, fronte sulcata, thorace latitudine fere triplo breviore, antrorsum sensim angustato, lateribus oblique rotundatis flavo-marginatis, punctato, basi medio late triangulariter excavato, versus latera oblique profunde impresso, elytris vitta marginali alteraque utrinque discoidali, lineisque reticulatis posticis flavis, spatiis relictis violaceo-nigris, striis punctatis postice et extrorsum impressis, interstitiis uniseriatim punctulatis; a humeris vix attenuatis, postice autem oblique angustatis, serratis apice conjunctim rotundatis; subtus punctata, densius ad latera, paulo pubescens. Long. ·34—·45.

Lec. Proc. Acad. Nat. Sc. Phila. 1858, 69.

Eagle Pass, Texas, collected by Mr. A. Schott. Varies in the breadth but not in the general arrangement of the elytral markings. No sexual difference is obvious except that the females are stouter and more cylindrical than the males; the last ventral segment has the usual short transverse subapical crest.

13. A. retifera, subcylindrica, nigro-ænea, longius hirta, thorace latitudine triplo breviore, punctato, antice angustato, lateribus rotundatis, medio late canaliculato, versus angulos oblique profunde impresso, elytris maculis flavis varie connexis, vittam reticulatam fere ad apicem extensam utrinque formantibus, guttaque apicali parva ornatis, striis punctatis, extrorsum et postice impressis, interstitiis uniseriatim punctulatis, postice oblique rotundatis, serratis; subtus punctata, subtilius ad abdominis medium, parce pubescens. Long. ·34.

Lec. Proc. Acad. Nat. Sc. Phila. 1859, 72.

Fort Tejon, California, one specimen, Mr. Xantus. The margin is yellow, interrupted by black spots, and more or less connected with the discoidal vitta. Last ventral segment as usual.

E.

14. A. texana, subcylindrica, obscura vix ænea, hirta, thorace latitudine duplo breviore, densius punctato, lateribus magis rotundatis, medio subcanaliculato, et ad basin impresso versus angulos foveato, elytris striis punctatis, interstitiis planis, uniseriatim punctulatis, elytris maculis pluribus parvis pallide flavis ornatis, apice oblique rotundatis serratis; subtus punctata, parcius in medio, parum pubescens. Long. ·25.

One specimen, Texas; Horace Haldeman, Esq. Closely related to the two following in general appearance, but differs by the hair being as long on the elytra as on the thorax: the latter is densely punctured as in the next species, but is less narrowed in front, and less rounded on the sides. The spots are small and irregular, three have a tendency to encircle the humerus, then a transverse one scarcely touching the margin, directed obliquely forwards, then three transverse ones, and a subapical dot. These spots will probably be found to vary in other specimens.

The last segment of the abdomen has no vestige of the subapical crest and groove seen in all the previous species.

15. A. tubulus, subcylindrica, obscura vix ænea, capite thoraceque longius, elytris breviter pubescentibus, thorace convexo, antrorsum angustato, fortiter punctato, lateribus magis rotundatis, ante basin latiore, puncto utrinque basali notato, elytris striis punctatis, interstitiis uniseriatim punctulatis, guttis pluribus parvis flavis ornatis, postice oblique rotundatis serratis; subtus æqualiter sat punctata, parum pubescens. Long. ·22—·33.

? Laporte & Gory, Mon. Buprest. 1, 11, tab. 3, fig. 15: Spinola, Ann. Ent. Soc. France, 7, 383.

Buprestis tubulus Fabr. Syst. El. 2, 200: Say, Trans. Am. Phil. Soc., 5, 200.

Buprestis culta Weber, Obs. Ent. 75.

Buprestis geranii Harris, New England Farmer, 1829, 8.

α. Variat; maculis elytrorum plus minusve deficientibus, vel etiam immaculatis.

β. Variat? thorace densius punctato, dorso canaliculato, maculis elytrorum anterioribus plus minus confluentibus, (Texas.)

Throughout the Atlantic region of the United States: the immaculate variety was given me by Mr. E. T. Cresson.

Two specimens from Texas, collected by Mr. Haldeman, agree in having the thorax distinctly channeled, and less coarsely but more densely punctured than in the more northern specimens; in one of them the spots are placed as usual, but in the other the anterior ones have become confluent so as to form a narrow irregular vitta from the base to the middle, where it reaches a spot connected with the margin. Should the difference in the sculpture of the thorax prove constant, it must be separated as a distinct species.

I have queried the reference to Laporte, because he gives the locality, Columbia, and states that the thorax is channeled.

F.

16. A. guttifera, subcylindrica, æneo-nigra nitida, parce longe albo-pilosa, thorace latitudine duplo breviore, convexo, lateribus rotundatis, apice fortius transversim impresso, basi medio profunde late foveato, fortiter punctato, elytris cyanescentibus, basi thorace paulo latioribus, postice obtusius rotundatis serratis, striis fortiter punctatis, postice et extrorsum impressis, externis duabus antice confluentibus haud abbreviatis, interstitiis subtiliter uniseriatim punctulatis, guttis flavis ornatis, 3 discoidalibus, 5 submarginalibus; subtus nigro-ænea, longe pilosa, punctata, abdominis articulis 3 ultimis confertissime subtiliter punctulatis. Long. ·28.

Lec. Proc. Acad. Nat. Sc. Phila. 1859, 72.

One specimen, Fort Tejon, California, Mr. Xantus.

GROUP V.

A very distinct group, recurring to the normal series, and readily distinguished by the antennæ being situated in round cavities: the epistoma is frequently emarginate in front and strongly narrowed behind: the mentum is corneous at base, membranous at apex. The prosternum is broad, strongly acuminate at tip, and also on each side; the mesosternum is large, and completely divided. The scutellum is elongate and acuminate; each elytron is rounded or subangulated at base, entering the base of the thorax, which thus becomes lobed: the membranous lobes of the basal joints of the tarsi are obsolete. But two genera are found within our territory, which differ by very many characters detailed by Lacordaire. The most obvious are, however, those derived from the tarsi.

Tarsi articulo 3io apice truncato, postici articulo 1mo reliquis æquali — Chrysobothris.
Tarsi articulo 3io apice utrinque valde prolongato, postici articulo 1mo 2ndo haud longiore — Actenodes.

Chrysobothris Esch.

A numerous genus, containing species which sometimes resemble each other very closely, and which from neglect of certain characters of value derived from the abdomen and tibiæ have been so described as to cause some confusion.

For the most convenient separation of the species into smaller groups, the following table may be used.

A. Abdomen segmento ventrali ultimo margine serrulato; (elytris costatis.)

a. Thorax æqualis; elytra foveis discretis impressa - - - - - - Sp. 1—2.

b. Thorax inæqualis; elytra foveis confluentibus, vel vix discretis;

α. Tibiæ anteriores ♂ intus serratæ, abdomen ♀ apice truncatum, præcipue subtridentatum. - - - - - - - - - - Sp. 3—8.

β. Tibiæ anticæ ♂ apice dilatatæ, vel versus apicem dente armatæ; abdomen ♀ apice subincisum - . - - - - - - - Sp. 9—18.

B. Abdomen segmento ventrali ultimo margine haud serrulato.

c. Elytra costata, impressa, apice acuminata - - - - - - Sp. 19.

d. Elytra subcostata, plus minus foveata, apice rotundata; thorax inæqualis.

α. Elytra foveis discoidalibus utrinque tribus inauratis - - - - Sp. 20.

β. Elytra foveis discoidalibus utrinque duabus - - - - - Sp. 21.

e. Elytra plus minus foveata, apice rotundata; thorax lateribus haud inæqualis.

α. Abdomen segmento ventrali ultimo linea submarginali fortiter serrata - - Sp. 22.

β. Abdomen segmento ventrali ultimo linea nulla elevata - - - Sp. 23—27.

f. Elytra basi sola foveata, fasciis atris ornata; thorax antrorsum angustatus, lateribus convexis Sp. 28—29.

A—a.

1. C. octocola, elongata, depressa, supra obscura, æneo-micans, punctata, thorace lateribus late rotundatis, antice sublatiore, elytris costis solitis tenuibus, fovea basali impressionibusque utrinque tribus inauratis, 2nda postice emarginata, postice serratis, apice singulatim rotundatis; subtus cupreo-ænea punctata, prosterno medio lævi. Long. ·44—·67.

Mas capite viridiæneo, pygidio haud carinato, segmento ventrali ultimo valde emarginato, tibiis anticis et intermediis curvatis, denticulis paucis internis armatis.

Femina capite æneo, pygidio carinato, segmento ventrali ultimo sinuatim truncato, dentibus externis acutis, medio parum prominulo, disco carinato: tibiis anticis paulo curvatis, intermediis fere rectis.

Lec. Proc. Acad. Nat. Sc. Phila. 1858, 67.

Texas, Arizona, and Colorado river of California: lives in species of Prosopis. The last ventral segment is provided with a submarginal elevated serrate line, and a smooth anterior triangular spot each side, which projects into an acute tooth: the segments of the abdomen are each furnished with a smooth lateral spot, and their posterior angles project strongly. The tooth of the anterior femora is serrate externally, but scarcely so internally: the third joint of the antennæ is more than twice as long as its width.

2. C. basalis, magis elongata, depressa, supra obscura, æneo-micans, punctata, thorace lateribus rectis, antice angulatis et obliquis, linea tenui dorsali, alteraque utrinque brevi basali lævibus, elytris costis solitis tenuibus, fovea basali, alterisque utrinque tribus subauratis, postice serratis, apice singulatim rotundatis; subtus cupreo-ænea, punctata, prosterno medio lævi. Long. ·7.

Mas capite viridi, pygidio haud carinato, segmento ventrali ultimo valde emarginato, tibiis anticis ultra medium, intermediis ad medium intus denticulatus, valde curvatis, antennarum articulis 3—7 dilatatis.

Femina capite æneo, vix virescente, pygidio carinato, segmento ventrali ultimo sinuatim truncato medio carinato, tibiis anticis valde curvatis, intermediis fere rectis.

Lec. Proc. Acad. Nat. Sc. Philad. 1858, 68.

? Chrysobothris Atabalipa Laporte & Gory, 2, 43, tab. 8, fig. 60.

Two specimens from Texas, collected by Mr. Schott. Resembles in appearance the preceding, but is more elongate, with smaller and less brilliant elytral impressions. Besides the characters mentioned above the femoral tooth is strongly serrate on its whole

margin. The figure of C. Atabalipa resembles this species, but the description, like all others of the first portion of the work quoted, makes no mention of any distinguishing characters. I will, therefore, leave the question of synonymy to be determined by any person into whose hands the original type may have fallen.

A—b, α.

3. C. exesa, latiuscula, obscure ænea, dense punctata, thorace lateribus rectis, apice subito inflexis, antice paulo latiore, inæquali, spatiis elevatis lævibus, elytris costa 1ma integra, reliquis omnino interruptis, transversim confluentibus, (ita ut fasciæ tres irregulares sublæves efformantur, tresque opacæ depressæ punctatæ, 1ma basalis, alteræ sinuatæ apparent,) serratis singulatim rotundatis; subtus cupreo-ænea, prosterno sat dense abdomine rude punctato, segmento ventrali ultimo spatio laterali lævi postice elevato instructo. Long. ·36—·42.

Mas latet. Femina segmento ventrali ultimo medio lævi subcarinato, apice late truncato, et subemarginato.

Lec. Proc. Acad. Nat. Sc. Phila. 1858, 68.

Arizona and Colorado River of California. The segments of the abdomen have smooth prominent lateral triangular spaces, which project behind. The tooth of that of the last segment is very obvious, as in C. octocola.

4. C. femorata, depressa præcipue minus elongata, obscura ænescens, punctata, thorace antice paulo latiore, plus minusve canaliculato, elytris costis solitis interruptis, impressionibus utrinque duabus fasciformibus, anteriore flexa, posteriore sinuata, lateribus serratis, apice singulatim rotundatis, subtus cupreo-ænea, prosterno præcipue linea lævi notato. Long. ·32—·63.

Buprestis femorata Fabr. Syst. El. 2, 208.

Mas capite sæpe viridi, pygidio haud carinato, segmento ventrali ultimo emarginato, tibiis anticis et intermediis curvatis, intus plus minusve serrulatis.

Femina pygidio carinato, segmento ventrali ultimo linea lævi antica basi latiore notato, apice sinuatim truncato, fere tridentato; tibiis intermediis fere rectis, anticis paulo curvatis.

Gens α. Major, latior, maculis elytrorum fasciformibus distinctis; mas capite haud virescente, tibiis anticis denticulis 2 vel 3 prominulis.

Chrysobothris Alabamæ Gory, Mon. Buprest. 4, 185, tab. 32, f. 183.

Gens β. Media, maculis elytrorum distinctis.

a. Mas capite æneo-obscuro, tibiis anticis dentibus 4—6 prominulis.

b. Mas capite viridi, tibiis anticis intus serrulatis.

Buprestis femorata Fabr. l. cit.; Oliv. Ins. 32, 47, tab. 4, f. 121; Herbst, Käfer, 9, 226, tab. 152, f. 4; Harris, New Engl. Farmer, 8, 2; Ins. Inj. to Veg. 44.

Chrysobothris quadriimpressa Laporte & Gory, Mon. Bupr. 2, 48, tab. 8, f. 64.

Chrysobothris dentipes ‡ Laporte & Gory, Mon. Bupr. 2, 52, tab. 9, f. 70.

Chrysobothris viridiceps Mels. Proc. Acad. Nat. Sc. Philad. 2, 147.

Chrysobothris rugosiceps Mels. ibid.

Gens γ. Minor, præcipue latior, maculis elytrorum distinctis, mas tibiis anticis intus serrulatis.

From Canada to Texas and the Rocky Mountains; race β—b is also found in Oregon and California. As is usual with species distributed over such a wide extent of country,

this exhibits the phenomenon of subspecies or *races*, which, however, should not be distinguished by different names, since frequent transitions may be found between them, and the characters which separate them are not similar to those which distinguish well defined species.

The ventral segments in this species have smooth triangular lateral spots, and their angles project; on the last segment this spot is somewhat elevated behind, but not dentiform as in C. octocola and basalis.

5. C. soror, depressa, obscura, ænescens, punctata, thorace subinæquali antice paulo latiore, vix obsolete canaliculato, punctis transversim confluentibus ruguloso, elytris costis solitis interruptis, impressione anteriore transversa quadrata, posteriore fasciformi sinuata, serratis, apice singulatim rotundatis; subtus cupreo-ænea, prosterno dense punctato. Long. ·40—·45.

Mas fronte viridi, corpore subtus viridi-tincto, pygidio haud carinato, abdominis segmento ventrali ultimo emarginato, tibiis anticis et intermediis curvatis, intus serrulatis.

Femina pygidio carinato, abdominis segmento ventrali ultimo sinuatim truncato, medio prominulo, tibiis anticis et intermediis parum curvatis.

Middle and Western States. So closely allied to C. femorata, that I separate it with some doubt; nevertheless, with several specimens before me, the anterior impression of the elytra seems to extend only as far as the subsutural costa, and there is no impressed spot anterior to it completing the fascia to the suture: the thorax is also only obsoletely or not at all channeled, and the punctures produce small transverse folds, not seen in C. femorata; otherwise there appears to be no special difference: the last ventral segment is, however, slightly less tumid anteriorly at the sides.

6. C. Lesueuri, depressa, obscura, ænescens, punctata, thorace subinæquali, canaliculato, antice paulo latiore, elytris costis solitis interruptis, fovea quadrata antica, alterisque duabus posticis fere confluentibus cuprascentibus, serratis, apice singulatim rotundatis; subtus cupreo-ænea, prosterno dense punctato, linea lævi notato. Long. ·40—·45.

Sexus differentia sicut in priore.

Laporte & Gory, Mon. Buprest. 2, 49, tab. 9, f. 66.

Middle and Southern States. Also closely related to the two preceding, but the anterior impression is a square fovea, situated on the second costa not extending to the subsutural, and the posterior impression is divided into two by the second costa; these two are obliquely placed, and are not confluent, though they sometimes nearly touch.

7. C. obscura, depressa, supra fere nigra, punctis ænescentibus, thorace subinæquali, canaliculato, elytris costis solitis, parce fortius punctatis, fovea quadrata antica, maculaque postica obliqua sinuata vage impressis, postice oblique angustatis serratis, apice singulatim breviter rotundatis; subtus cupreo-ænea, prosterno dense punctato. Long. ·45.

Mas capite viridi, segmento ventrali ultimo emarginato, tibiis anticis et intermediis curvatis, intus serrulatis.

Femina pygidio carinato, segmento ventrali ultimo sinuatim truncato, ad basin linea lævi subelevata notato, tibiis anticis paulo curvatis, intermediis subrectis.

Southern and Western States. Also related to the three preceding species, but may be distinguished by the coarser and more sparse punctures of the elytra, and the more vague impressions. The thorax in my two specimens is scarcely wider in front, but I do not know if this will prove a constant character.

8. C. misella, latiuscula, depressa, obscura, ænescens, inæqualiter punctata, thorace inæquali, canaliculato, lateribus late roundatis, antice multo latiore, elytris costis solitis, hic inde dilatatis, suturali postice undulata, fasciis duabus densius punctatis ænescentibus, serratis apice singulatim rotundatis; subtus cupreo-ænea, prosterno dense punctato. Long. ·30.

Mas capite virescente, segmento ventrali ultimo emarginato, tibiis anticis et intermediis curvatis, intus paulo serrulatis.

Femina haud obvia.

Three males; Saratoga, Mr. James Thomson. Differs from the smallest C. femorata by its still smaller size, and by the punctures, (especially of the elytra,) being irregularly diffused so as to leave occasional almost smooth spaces, and by the subsutural costa being undulated towards the tip of the elytra; the impressed spots are, as in the species mentioned, a transverse anterior fascia, completed by a subsutural spot, anterior to its main direction, and a posterior sinuated band.

A—b β.

9. C. quadrilineata, fusco-ænea, fortiter punctata, obscura, latiuscula, depressa, thorace sulco dorsali profundo, costis duabus latis, calloque utrinque elongato sublævibus, elytris costis solitis tribus lævibus interruptis, secunda bis late dilatata. Long. ·5—·57.

Mas segmento ventrali ultimo emarginato, tibiis anticis curvatis, apice dilatatis; prosterno dense hirto, linea media glabra lævi.

Femina latet.

Santa Fé, New Mexico, Mr. Fendler. Robust, depressed, dull bronze, head very densely punctured, with two smooth spots between the eyes, and an occipital bifurcating line; front coppery; labrum green; antennæ green; third joint as long as the two following; thorax twice as wide as its length, rounded on the sides, deeply lobed at base; dorsal groove deep, densely punctured, sides rugosely punctured, with a large longitudinal callus extending from the tip nearly to the base, and a broad, shining, nearly smooth costa, contiguous to the dorsal groove. Elytra wider than the thorax, obliquely narrowed and finely serrate behind, then sparsely rounded at the apex; subsutural costa entire, gradually dilated towards the base, second costa reaching nearly to the tip, dilated at one quarter the length so as to join the third, and again more broadly behind the middle so as to touch the subsutural, then slightly interrupted; third, slender, interrupted behind, and confluent

with the second; fourth, slender, posterior, submarginal, reaching the apex; a short oblique elevated line runs from the base of the second to the subsutural, which it reaches opposite the first dilatation of the second costa. These elevations are all smooth and shining, the depressions are more coppery and densely punctured; body beneath dark-coppery, shining, coarsely punctured; prosternum flat, densely punctured, hairy, with a smooth medial line. Last segment of the abdomen with the sides oblique, lateral groove limited internally by a not very obvious serrate elevated line; lateral posterior angles of the other segments acute prominent.

10. C. texana, elongata, obscure ænea, subcinerea, punctata, thorace lateribus rectis, antice latiore, transversim rugoso, medio parcius punctato, subcanaliculato, lateribus impresso et callo angusto notato, elytris costis solitis interruptis, 2nda bis dilatata, spatiis fere lævibus, impressionibus vagis, lateribusque densius punctatis, serratis apice singulatim rotundatis, subtus fortiter, sterno densius punctato. Long. ·42.

Mas segmento ventrali ultimo emarginato, tibiis anticis curvatis, apice subito dilatatis et oblique sulcatis, intermediis paulo curvatis.

Femina latet.

One specimen from Texas in the collection of Mr. Ulke. Behind the posterior impression, a little ridge, a part probably of the 2nd costa, becomes confluent with the subsutural costa, which is entirely straight. I do not know whether this will prove to be a permanent character.

11. C. calcarata, subdepressa, obscure ænea, fortiter punctata, thorace dorso sulcatō, costis parcius punctatis, lateribus paulo inæquali, elytris costis solitis interruptis, intermedia postice fere obsoleta, impressione postica transversa, apice serratis singulatim rotundatis; tibiis intermediis fere rectis. Long. ·35—·50.

Mas segmento ventrali ultimo breviter emarginato, tibiis anticis paulo curvatis ultra medium dente interno magno acuto armatis.

Femina segmento ventrali ultimo apice subinciso, tibiis anticis paulo curvatis.

Mels. Proc. Acad. Nat. Sc. Phila. 2, 149.

Chrysobothris femorata ‡ Laporte & Gory, Mon. Bupr. 2, 48, tab. 9, f. 65.

Middle and Southern States, not rare. In form and general appearance, resembles C. dentipes, but is usually smaller and readily distinguished by the above characters. The posterior elytral impression is composed of two confluent lobes, forming a transverse spot; in C. dentipes the same spot is oblique.

12. C. cuprascens, obscure cuprea, punctata, thorace subinæquali, subcanaliculato, lateribus rotundatis, elytris costis solitis interruptis, spatiis quadrato mox ante medium, alteroque postice majore impressis densius punctatis, serratis, apice singulatim rotundatis, subtus cupreo-ænea, prosterno dense punctato. Long. ·30.

Mas capite ænescente, segmento ventrali ultimo emarginato, tibiis anticis paulo curvatis ultra medium dente magno armatis, posterioribus rectis.

Femina latet.

A single male from Santa Fé, New Mexico; Mr. Fendler. All the depressed portions

of the elytra are densely punctured, the first costa extends from the tip nearly to the base; the second commences at the middle of the base and reaches nearly to the tip; it is broadly interrupted by two quadrate impressions; the first, just in front of the middle; the second, slightly sinuate, behind the middle; the third costa is interrupted only by the posterior impression, immediately behind which it unites with the second.

13. C. dentipes, depressa, supra nigra cuprascens, fortiter punctata, thorace dorso sulcato, costis parcius punctatis, lateribus inæquali, elytris costis 3 solitis interruptis, impressionibus obliquis, apice serratis singulatim rotundatis. Long. ·46—·64.

Mas segmento ventrali ultimo emarginato, tibiis intermediis versus apicem intus subdilatatis, anticis parum curvatis apice sublatioribus.

Femina segmento ventrali ultimo apice minute inciso tibiis anticis et intermediis parum curvatis.

Buprestis dentipes Germ. Ins. Nov. 58.

Buprestis characteristica Harris, New Engl. Farmer, 8, 2.

Chrysobothris planata Laporte & Gory, Mon. Bupr. 2, 56, tab. 10, f. 77.

Lake Superior to Georgia: abundant. Readily known by the flat body, sulcate thorax and dark colour of the upper surface.

The last ventral segment in this and the next species is triangular, the sides nearly straight, with a submarginal groove, inside of which the surface is simply convex, without any distinct elevated line. The abdominal segments do not project strongly on the sides.

14. C. trinervia, depressa, obscura, punctis æneis, thorace inæquali sulcato, spatiis pluribus elevatis sublævibus, lateribus fere parallelis, elytris costis solitis interruptis et lineis transversis elevatis lævibus varie connexis, spatiis depressis dense punctatis, serratis apice singulatim rotundatis; subtus purpureo-ænea, medio cyanescens, prosterno rude punctato, tibiis posticis rectis. Long. ·42—·45.

Mas fronte prosterno femoribusque anticis viridibus, segmento ventrali ultimo emarginato, tibiis anterioribus curvatis, anticis apice oblique sulcatis et dilatatis.

Femina segmento ventrali ultimo apice anguste inciso, spatio basali triangulari lævi, tibiis intermediis subrectis, anticis curvatis.

Buprestis (*Odontomus*) *trinervia* Kirby, Fauna Bor. Am. 4, 157, tab. 2, f. 9: Mann. Bull. Mosc. 1853, 220.

Chrysobothris cicatricosa Motsch. Et. Entom. 1852, 77.

Lake Superior, Lake Winnipeg, Oregon and Washington Territories, and California. The colour beneath is somewhat variable. I have a male with the body entirely green, and a female in which it is coppery, with purple spots at the sides of the abdomen. The sides of the thorax are sometimes straight, sometimes rounded, but it is never obviously wider in front.

15. C. scabripennis, depressa, obscure cupreo-ænea, inæqualiter punctata, thorace inæquali sulcato, spatiis pluribus elevatis sublævibus, antice latiore, elytris costis solitis interruptis lineis transversis elevatis lævibus varie connexis, spatiis depressis dense punctatis, serratis, apice singulatim rotundatis; subtus cuprea, prosterno rude punctato, tibiis posticis curvatis. Long. ·37—·42.

Sexus differentia sicut in præcedente, sed tibiæ posticæ maris curvatæ.

Laporte & Gory, Mon. Bupr. 2, 53, tab. 9, f. 71.

New York, Maine, Lake Superior. Closely resembles the preceding, but the thorax is more abbreviated, and distinctly dilated in front, the costæ of the elytra are narrower and less connected by transverse smooth lines, the colour is more coppery, and finally the posterior tibiæ are curved, especially in the males.

16. C. pusilla, obscure cuprea, fere æqualiter dense punctata, thorace latitudine fere duplo breviore, lateribus rotundatis, subinæquali, sulco dorsali tenui, elytris costis tenuibus præcipue postice subreticulatis, fovea ante medium, fasciaque postica obliqua vage impressis, subtiliter serratis, apice singulatim rotundatis; subtus ænea, prosterno sat dense punctato. Long. ·25—·32.

Mas segmento ventrali ultimo emarginato, tibiis anticis curvatis, ad apicem intus subito dilatatis, intermediis curvatis apice sublatioribus.

Femina segmento ventrali ultimo apice anguste emarginato, tibiis anticis paulo curvatis, reliquis rectis.

Laporte & Gory, Mon. Bupr. 2, 53, tab. 10, f. 72.

Chrysobothris strangulata Mels. Proc. Acad. Nat. Sc. Phila. 2, 147.

Middle and Southern States, rare. Differs from the following by the broader form and more densely punctured upper surface, as well as by the slightly unequal thorax, somewhat reticulated elytral costæ and more finely serrate elytra. The species varies somewhat in the form of the thorax, and in the elytral impressions: in some specimens the former is scarcely one half wider than its length, and the disc each side of the dorsal groove is less punctured: on the elytra the anterior impression is usually a vague fovea, but is sometimes prolonged obliquely upwards and outwards; the posterior one is oblique and sinuate, sometimes not very distinct: the costæ are narrow, and have a tendency to be connected by reticulations especially behind and outside of the posterior impression.

17. C. debilis, elongata, piceo-ænea, punctata, thorace latitudine vix sesqui breviore, lateribus parallelis, postice incurvis, transversim rugoso vix vage impresso, elytris costis parum distinctis, 3ia obsoleta, fovea quadrata ante medium, maculaque transversa sinuata pone medium impressis, cuprascentibus, serratis, apice singulatim rotundatis; subtus ænea, dense punctata, longius pubescens, abdomine medio parce punctato. Long. ·30.

Mas segmento ventrali ultimo emarginato, tibiis anticis apice intus breviter dilatatis. Femina latet.

Western States: one male from Ohio, Dr. Schaum. The thorax is not all channeled, the punctuation is regular, and the elytral costæ straight.

18. C. disjuncta, cuprea, elongata, thorace punctato, transversim rugoso, latitudine vix sesqui breviore, lateribus parallelis postice incurvis, haud impresso, elytris sat dense minus subtiliter punctatis, costis solitis parum distinctis, fovea magna quadrata ante medium, alterisque duabus transversim positis pone medium impressis, serratis, apice singulatim rotundatis; subtus ænea, sterno dense punctato. Long. ·30.

Mas segmento ventrali ultimo emarginato, tibiis anticis paulo curvatis ad apicem breviter dilatatis. Femina latet.

One specimen, Arizona. Related to the preceding, but differs by the punctures of the

elytra being coarser than those of the thorax, and by the posterior impression being divided into two foveæ.

B—c.

19. C. acuminata, ænea, thorace antice latiore, lateribus rectis prope apicem angulatis, punctato, parcius in disco, ad latera inæquali, elytris costis solitis interruptis, plagis elevatis sublævibus nitidis, alterisque depressis punctatis ornatis, serratis, apice singulatim acuminatis et spinula brevi armatis; subtus cupreo-ænea, sterno fere lævi. Long. ·44—·67.

Mas segmento ventrali ultimo postice late sulcato valde emarginato, apice utrinque bidentato, tibiis anticis et intermediis curvatis, intus serrulatis.

Femina segmento ventrali ultimo late truncato, angulis acutis prominulis, medio carina integra lævi signato, tibiis anterioribus paulo curvatis.

Tamaulipas, extending to Matamoras and probably into Texas; Dr. Berlandière. Quite distinct by the above characters from all the other species seen by me. The impressed spots are almost as in Chalcophora virginiensis.

B—d, α.

20. C. gemmata, depressa, supra læte purpurea, capite valde punctato, viridi-aureo, inæquali, cupreo-maculato, thorace tenui canaliculato, versus latera inæquali, viridi-aureo variegato, punctato parcius in disco, elytris sat dense æqualiter punctatis, costis solitis tenuibus interruptis, impressionibus utrinque 4 laete inauratis, strigaque subhumerali ornatis, 2nda et 3ia postice emarginatis; subtus viridiænea, purpureo-variegata nitida, prosterno medio parce subtiliter punctato. Long. ·88.

Femina segmento ventrali ultimo carina lævigata postice sensim attenuata, apice truncato, tibiis intermediis rectis, anticis paulo curvatis. Mas latet.

Lec. Proc. Acad. Nat. Sc. Phila. 1858, 67.

Two specimens collected by Mr. Arthur Schott in Arizona. The antennæ are purple, the third joint is as long as the three following. The last ventral segment is elongate, oblique, and even a little concave on the sides; the marginal groove is limited by an internal elevated serrate line; the posterior angles of the other segments are very prominent.

B—d, β.

21. C. sexsignata, obscura, subænescens, rude punctata, thorace brevi, lateribus præcipue subrectis, transversim rugoso, linea dorsali sæpissime lævi, interdum obsoleta, elytris costis parum distinctis, fovea basali, altera ante medium, tertiaque majore pone medium impressis, sæpissime cuprascentibus, serratis apice singulatim rotundatis; subtus sæpissime purpurea, medio cyanea, (nonnunquam ænea, medio viridis,) sterno dense punctato. Long. ·28—·50.

Mas capite viridi, segmento ventrali ultimo obsolete carinato, apice emarginato, tibiis anticis et intermediis curvatis, his paulo serrulatis.

Femina segmento ventrali ultimo carinato, apice minute emarginato, tibiis anterioribus paulo curvatis.

Buprestis sexguttata || Say, Journ. Acad. Nat. Sc. Phila. 3, 161.

Buprestis sexsignata Say, Trans. Am. Phil. Soc. 6, 158.

Chrysobothris Germari Laporte & Gory, Mon. Bupr. 2, 50, tab. 9, f. 67.

Chrysobothris ignipes Laporte & Gory, ibid., tab. 9, f. 68.

From Massachusetts to the Rocky Mountains. Varies very much in size, and also in form, but the punctuation more coarse than usual, and the posterior elytral impression forming but a single fovea, extending internally only to the 2nd costa, will readily distinguish it from all others found in the United States. The feet vary much in colour, usually they are bright copper, sometimes, however, they are green.

B—e, α.

22. C. analis, longiuscula, supra viridi vel purpureo-æenea, obscura, thorace lateribus rectis, punctato, valde transversim rugoso, elytris fortiter punctatis, costis fere obsoletis, ante medium oblique impressis, serratis, apice singulatim rotundatis; subtus nigro-æenea, sterno fortiter punctato, segmento ventrali linea submarginali acute elevata, fortiter serrata. Long. ·31.

Mas segmento ventrali ultimo emarginato.

Femina segmento ventrali ultimo truncato, angulis prominulis, linea transversa subapicali acute elevata.

Matamoras; Dr. Berlandière: a fine green variety was received by Mr. Ulke from Texas. The serrate line of the last ventral segment is parallel with the margin and limits the usual submarginal groove; in the female this line is connected with the one on the opposite side by a transverse acutely elevated subapical line.

B—e, β.

23. C. hybernata, nigro-purpurea, vel atra, latiuscula, aequaliter fortiter punctata, thorace lateribus parallelis antice angulatis, elytris haud costatis, fovea basali, altera ad medium majore, duabus pone medium transversim positis, maculaque parva laterali ante medium læte viridiaureis, fortius serratis, apice rotundatis; subtus nigro-æenea, fortiter punctata, sterno densius punctato. Long. ·28—·30.

Sexus differentia latet.

Buprestis hybernata Fabr. Syst. El. 2, 209.

Chrysobothris viridipunctata Laporte & Gory, 2, 21, tab. 4, f. 31.

? *Chrysobothris hybernata* Laporte & Gory, 2, 16, tab. 4, f. 24.

Buprestis chrysellus Illiger, Wiedem. Archiv. 1, 2, 122 (fide Laporte.)

Southern States. Six specimens are before me, all agreeing in having the last ventral segment truncate, with the angles prominent and acute. The gold of the basal fovea sometimes extends along the base to the humerus. The descriptions belonging to the two quotations from Laporte and Gory do not appreciably differ; the figure last quoted wants the lateral golden spot in front of the middle of the elytra, and the elytra are not represented as black.

24. C. concinnula, elongata, capite thoraceque viridi-æneis, rugose punctatis, hoc latitudine vix breviore, lateribus fere rectis, elytris haud costatis, atrocyaneis, haud dense fortiter punctatis, fovea basali, alteraque ad me-

dium viridiæneis, fascia haud impressa postica virescente ornatis, fortius serratis; subtus obscure cyanea, sterno dense, abdomine modice punctato, articulis intermediis parce punctatis. Long. ·27.

Femina segmento ventrali ultimo truncato, angulis prominulis.

One specimen, Missouri. Much narrower than the next, with the elytra entirely without costae, and the posterior fovea replaced by a transverse greenish band not at all impressed.

25. C. azurea, latiuscula, læte cyanea, vel viridi-cyanea, æqualiter fortiter punctata, thorace brevi, lateribus rectis, postice incurvis, elytris costis obsoletis, fovea basali altera ad medium tertiaque postica impressis sæpe viridiæneis, serratis, apice rotundatis; abdomine parce, prosterno dense punctato. Long. ·30.

Mas segmento ventrali ultimo emarginato.

Femina segmento ventrali ultimo subcarinato, truncato, angulis prominulis.

Lec. Proc. Acad. Nat. Sc. 1857, 8.

Chrysobothris ultramarina ‡ Laporte & Gory, Mon. Bupr. 2, 13, tab. 3, f. 19.

Variat, capite thoraceque purpureis, elytris obscure cyaneis, foveis subviridibus.

Southern States. The variety approaches somewhat the description of C. thoracica, but the thorax is not bright coppery, nor are the elytra black: the locality given by Fabricius is the Island of St. Thomas, and I do not know on what authority Laporte and Gory give it as North American. The sides of the body and legs are sometimes coppery purple.

26. C. Harrisii, latiuscula, viridi-ænea, thorace brevi punctato et rugoso, lateribus rectis postice incurvis, dorso canaliculato, elytris sat dense punctatis, costis fere obsoletis, fovea ad medium lata profunda, duabusque vagis oblique positis, subtiliter serrulatis, apice rotundatis; abdomine modice, sterno dense punctato. Long. ·30.

Mas segmento ventrali ultimo emarginato, tibiis anticis apice dilatatis.

Femina segmento ventrali rotundato, apice subemarginato.

Buprestis Harrisii Hentz, Journ. Acad. Nat. Sc. Phila. 5, 373, tab. 13, f. 1; Harris Ins. Inj. to Vege. 44.

Massachusetts, in twigs of white pine. The whole sternum, the legs and the sides of the thorax of the male, are of a more brilliant green, and somewhat coppery. This species resembles closely the preceding, but the elytra are less coarsely punctured and more finely serrate, and the posterior impression is not a single fovea, but two indefinite ones placed obliquely.

C. scitula *Gory*, and C. chlorocephala *Gory* seem to be closely allied to this species, but not sufficiently to enable me to suppress them into synonyms.

27. C. aeneola, latiuscula, obscure ænea, æqualiter punctata, thorace brevi, lateribus postice incurvis, transversim rugoso, canaliculato, elytris costis obsoletis, impressione obliqua ante medium, alteraque postica vagis, vix obsolete serratis, apice rotundatis, abdomine modice, sterno fortius punctato. Long. ·26—·30.

Mas segmento ultimo ventrali emarginato, cristaque parva transversa anteapicali instructo; tibiis anticis apice breviter dilatatis.

Femina segmento ventrali ultimo rotundato, apice subemarginato.

Fort Riley, Kansas; Mr. John Xantus. Somewhat narrower than the preceding, and resembling on account of its form and colour a large Anthaxia.

B—f.

28. C. Ulkei, latiuscula cyaneo-viridis, capite foveato, haud dense punctato, thorace brevi, antice angustato, lateribus convexis rotundatis postice valde incurvis, confertim punctato, linea dorsali postica lævi, elytris confertim punctatis, haud costatis, foveis basalibus solis impressis, macula utrinque triangulari ante medium, fascia media introrsum sensim latiore, alteraque postica obliqua atris, serratis, apice rotundatis, abdomine paulo brevioribus; subtus fortiter, sterno dense punctato. Long. ·60.

Femina segmento ventrali ultimo apice rotundato. Mas latet.

One specimen from Texas in the collection of Mr. Ulke, to whom I owe the opportunity of describing it.

29. C. nigrofasciata, læte viridiænea, latiuscula, supra æqualiter fortiter sat dense punctata, thorace brevi, antice angustato, lateribus convexis rotundatis postice parum incurvis, elytris foveis basalibus solis impressis, maculis utrinque tribus, postica obliqua, nigro-cyaneis ornatis, serratis, apice rotundatis, abdomine breviobus; subtus fortiter sat dense punctata. Long. ·47—·58.

Mas segmento ventrali ultimo late emarginato, angulis prominulis, antennis subpectinatis articulis 4—10 angulo externo prolongato.

Femina segmento ventrali ultimo subtruncato, angulis obtusis, antennis serratis.

Laporte & Gory, Mon. Bupr. 2, 21, tab. 3, fig. 32.

New Mexico, collected in May and June by Capt. J. Pope, while exploring the Llano Estacado: also found in Mexico.

The following species are unknown to me, or cannot be identified.

C. nigritula Lap. & Gory, Mon. Bupr. 2, 54, tab. 10, f. 73.
C. scitula Gory, Mon. Bupr. 4, 160, tab. 27, f. 155.
C. chlorocephala Gory, Mon. Bupr. 4, 161, tab. 27, f. 156.
C. errans Gory, Mon. Bupr. 4, 172, tab. 29, f. 167.
C. rugosula Gory, Mon. Bupr. 4, 177, tab. 30, f. 172.
C. floricola Gory, Mon. Bupr. 4, 179, tab. 30, f. 175.
C. dissimilis Gory, Mon. Bupr. 4, 181, tab. 31, f. 177.

Actenodes Lac.

1. A. bella, latiuscula, fusca, dense æneo-punctata, thorace transversim biimpresso, subrugoso, lateribus fere rectis, antrorsum paulo angustato, angulis posticis acutis, elytris transversim rugosis macula basali, duabus ante medium transversim positis, alteraque pone medium læte viridiaureis, sutura antice auro-micante, serrulatis apice vix rotundatis. Long. ·55.

One specimen, Liberty county, Georgia. The head is channeled from the front to behind the middle; the eyes nearly meet on the occiput. The body beneath is strongly,

on the sternum densely punctured. The last ventral segment is broadly truncate with the angles prominent, and armed on the side with a tooth.

2. A. acornis, supra atra, vix ænescens, thorace confertim rugose punctato, transversim impresso, lateribus vix rotundatis fere parallelis, elytris dense fortiter scabro-rugosis, impressionibus vagis inæqualibus, serratis apice conjunctim subrotundatis; subtus nigro-ænea, vel cyanea nitida, punctata, sterno sæpe cuprascente dense punctato. Long. ·4—·47.

Buprestis acornis Say, Trans. Am. Phil. Soc. 6, 159.

Chrysobothris punctata Mels. Proc. Acad. Nat. Sc. 2, 147.

New York, Georgia, Mexico. The head in one specimen is tinged with green; the under surface varies greatly in colour, being either bronzed, black-bronzed, or dark blue. In five specimens before me the last ventral segment is truncate, with prominent angles; and has the lateral tooth strongly marked. The eyes approximate closely on the occiput.

GROUP VI.

In this group are species mostly of a linear form, having the antennæ inserted in large cavities, by which the epistoma is very much narrowed behind; it is usually broadly emarginate in front. The anterior part of the head is vertical, and the mouth is applied to the prosternum. The mentum is large, triangular and entirely corneous. The prosternum is broad, cuneate behind, scarcely angulated on the sides: the mesosternum usually moderate in size, completely divided. The scutellum in our species is transverse, acuminate behind, and usually transversely carinate, but in some foreign genera it is simply triangular. Each elytron is rounded or subangulated at base, so as to enter the base of the thorax, which thus becomes lobed. The tarsi are long, or moderate, and the ungues are strongly toothed. But two genera are found in the United States, to be distinguished by the form of the tarsi.

Tarsi postici articulo 1mo vix longiore - - - - - -	Coraebus.
Tarsi postici articulo 1mo sequentibus 3 æquali - - - - -	Agrilus.

Coræbus Lap. (emend. Lac.)

1. C. cogitans, capite valde excavato, thoraceque obscure cupreis, hoc dense punctato, utrinque irregulariter maxime excavato, lateribus nigro-marginatis, elytris atris granulatis, fascia ad dodrantem alteraque subapicali obsolete cinereo-pubescentibus, subtus æneoniger. Long. ·32—·37.

Buprestis cogitans Weber, Obs. Ent. 75.

Buprestis ignara Fabr. Syst. El. 2, 211.

Agrilus cogitans Say, Trans. Am. Phil. Soc. 6, 164.

Eumerus ignarus Laporte & Gory, Mon. Bupr. 2, 4, tab. 1, f. 5.

Rhæboscelis cogitans Lec. Ent. Writings of Say, 2, 598.

Middle, Southern and Western States. Lacordaire has restricted Rhæboscelis to species

having antennal grooves on the sides of the thorax; and there appears to be no reason why the present species should not be placed in Coræbus. The prosternum is not lobed, but truncate anteriorly. C. caliginosus *Lap.* seems to be merely the common European C. rubi, with an erroneous locality.

Agrilus Solier.

The species of this genus are numerous, and quite difficult to distinguish, and I am not without fear that in some cases with more abundant material for examination I may be found to have made errors. I have, however, endeavoured to prevent any ambiguity in identifying such forms as I have had before me, by calling particular attention to those characters in which they differ from those most closely allied.

According to the form of the ungues, our species constitute two large groups, to a certain extent parallel with each other, and in which species occur strongly resembling those of the opposite series.

A. Ungues fere fissi, basi sub-connati, partibus internis arcuatis, apice contiguis.

* a. Elytra atra, subtilius confertissime granulata; capit thoraxque cuprea - -	Sp. 1—3.
* * Elytra plus minusve metallica, minus subtiliter granulato-punctata.	
b. Frons subconvexa, subglabra - - - - - - -	Sp. 4—9.
c. Frons planissima pubescens (elytra fere seriatim punctata.) - - - -	Sp. 10.

B. Ungues vel acute vel præcipue late dentati, dentibus apice haud contiguis.

* d. Thorax lateribus dense pubescentibus; elytra subtilissime granulata - -	Sp. 11.
* * Thorax pube haud vittatus.	
e. Elytra impressionibus pubescentibus ornatis - - - - -	Sp. 12—17.
f. Elytra impressionibus pubescentibus nullis - - - - - -	Sp. 18—32.
(Elytra densius granulato-punctata:	
Scutellum carinatum - - - - - - -	Sp. 18—22.
Scutellum planum - - - - - - -	Sp. 23.
Elytra fortius granulato-punctata: - - - - - - -	Sp. 24—32.)

A—a.

1. A. fuscipennis, capite valde excavato, thoraceque cupreis, hoc vittis duabus pupureis, valde canaliculato, utrinque late excavato, elytris atris, subtus nigro-ænea. Long. ·47—·51.

Gory, Mon. Bupr. 4, 238, tab. 29, f. 230.

Southern and Western States: the largest of our species.

2. A. arcuatus, fronte haud canaliculata, capite postice excavato, thoraceque cupreis, hoc fortius rugose punctata, antice transversim, postice et utrinque oblique valde impresso, angulis posticis obtuse carinatis, elytris atris, subtus nigro-ænea. Long. ·25.

Say, Trans. Am. Phil. Soc. 6, 162.

Buprestis arcuata Say, Ann. Lyc. Nat. Hist. New York, 1, 251.
Agrilus cupricollis Gory, Mon. Bupr. 4, 240, tab. 41, f. 232.

Southern States: differs from the rest by the impressed line not extending upon the front, by the coarser punctures of the thorax, by the deep transverse impression near the anterior margin, and by the obtusely carinate posterior angles. In one specimen there is a deep dorsal canal, which in the other is wanting.

3. A. ruficollis, fronte canaliculata, capite postice excavato, thoraceque cupreis, nonunquam nigro-violaceis, hoc rugose punctato, utrinque oblique impresso, elytris atris; subtus nigro-ænea. Long. ·53—·30.

Say, Trans. Am. Phil. Soc. 6, 161: Laporte and Gory, Mon. Bupr. 2, 60, tab. 13, f. 70.

Buprestis ruficollis Fabr. Ent. Syst. 1, 2, 214: Syst. El. 2, 215. Oliv. Ins. 32, 78, tab. 9, f. 101. Herbst, Col. 9, 249, tab. 155, f. 9.

Middle, Southern, and Western States: the larva, as observed by Prof. S. S. Haldeman, lives in the interior of stalks of Rubus.

A—b.

4. A. torquatus, valde elongatus, æneus. capite canaliculato viridi, occipite cupreo fortiter dense punctato, thorace medio purpuro, late canaliculato et biimpresso, lateribus cupreis subrectis oblique impressis, angulis posticis longe carinatis, elytris nigro-olivaceis, lateribus rectis dense granulatis, costa discoidali parum distincta, apice serratis rotundatis. Long. ·30.

One specimen from Kentucky, Mr. J. Ph. Wild. Differs from A. arcuatus by the head less excavated, and the elytra more strongly granulate. The scutel is smooth, brassy, and not very strongly carinate: the elytra are narrowed regularly from the base nearly to the lip. The antennæ are a little shorter than the head and thorax, green and strongly serrate.

5. A. fulgens, æneus, capite canaliculato viridi, occipite æneo fortiter dense punctato, thorace cupreo, lateribus late rotundatis, profunde oblique impressis, medio canaliculato, et biimpresso, angulis posticis longe carinatis, elytris purpureis, lateribus sinuatis, fortius granulatis, apice serratis rotundatis. Long. ·26.

One specimen, Missouri, Mr. Schuster. Also differs from A. arcuatus by the same characters as the preceding, from which it is at once known by its smaller size and different form: the oblique impressions of the thorax meet at the middle.

A specimen from Illinois entirely of a golden color appears to be a variety of this species.

6. A. obliquus, æneus, capite modice punctato fere glabro canaliculato, thorace rugose punctato, dorso canaliculato, lateribus late rotundatis, profunde oblique impressis, angulis posticis longe carinatis, elytris obscurioribus, dense subtilius granulatis, apice serrulatis obtusius rotundatis. Long. ·32.

One specimen, Eagle Harbor, Lake Superior. Allied to the three following species, but

is distinguished by the more convex and less densely punctured head, and the very profound oblique lateral impressions of the thorax.

7. A. defectus, obscure-æneus, capite cuprascente, sat fortiter haud dense punctato, canaliculato, thorace latitudine haud breviore, vage impresso, lateribus subrotundatis impressis, angulis posticis brevissime fere obtuse carinatis, basi bifoveato, elytris fortiter dense granulatis, subunicostatis, apice singulatim rotundatis, serrulatis. Long. ·16—·19.

Western States and Pennsylvania, Kansas. Differs from A. æneus and other species of division B. by the much shorter and almost obsolete basal carinæ of the thorax, as well as by the form of the ungues.

8. A. otiosus, valde elongatus, supra obscure viridis, capite subtilius granulato-punctato, postice vix impresso, thorace latitudine haud breviore vage impresso, lateribus rectis, modice impressis, angulis posticis breviter, sæpe fere obsolete carinatis, basi bifoveato, elytris obscurioribus dense granulatis subunicostatis, apice rotundatis serrulatis. Long. ·16—·21.

Say, Trans. Am. Phil. Soc. 6, 163.

?*Agrilus virens* Gory, Mon. Bupr. 4, 259, tab. 43, f. 252.

Middle and Western States, Kansas. Differs from A. egenus chiefly by the head being more finely punctured, and the thorax less strongly rugous, with the basal carinæ shorter sometimes almost obsolete, and by the form of the ungues.

9. A. pusillus, obscure viridiæneus, capite convexiusculo modice punctato, subcanaliculato, thorace latitudine haud breviore, cyaneo variegato, lateribus subrotundatis profunde impressis, angulis posticis carinatis, basi bifoveato, elytris fortiter granulatis, apice serrulatis rotundatis et subacuminatis. Long. ·12.

Say, Trans. Am. Phil. Soc. 6, 162.

Buprestis pusilla Say, Am. Syc. Nat. Hist. New York, 1, 252.

One specimen, Kansas. Smaller than any other species known to me. In addition to the above characters the punctures of the thorax are more distinct than usual, so that it appears rather reticulate than rugous.

A—c.

10. A. difficilis, elongatus, supra obscurus, æneo vel cupreo-tinctus, subnitidus, capite plano, luteo-pubescente, postice breviter sulcato, thorace rugoso, vage impresso, lateribus subrectis, postice subsinuatis anguste impressis, angulis posticis longe carinatis, elytris punctis fere subseriatis, postice confuse granulatis, apice serratis rotundatis; subtus cupreo-æneus, abdomine utrinque maculis luteo-pubescentibus serie duplici ornatis. Long. ·36—·50.

Gory, Mon. Bupr. 4, 224, tab. 37, f. 215.

Agrilus occidentalis Uhler, Proc. Acad. Nat. Sc. Phila., 7, 416.

Western States, Dr. Harris and Mr. J. Ph. Wild. A very distinct species, but so indefinitely described by Mr. Gory, that were it not for his mentioning the hairy yellow spots of the abdomen, the determination would be doubtful, or indeed impracticable. One

series of these spots is marginal, above the lateral suture, the other is ventral, larger, triangular and less distinct.

B—d.

11. A. bilineatus, viridi-ater, granulatus capite, postice modice sulcato, thorace lateribus, elytrorumque vitta utrinque aureo-pubescente, angulis posticis haud carinatis; subtus æneus, punctatus, abdominis margine pleurisque aureo-pubescentibus. Long. ·28—·37.

Variat pube fere albida.

Say, Trans. Am. Phil. Soc. 6, 162.

Buprestis bilineata Weber, Obs. Ent. 74: Say, Ann. Lyc. New York, 1, 250.

Agrilus bivittatus Kirby, Fauna Bor. Am. 4, 161.

Agrilus flavolineatus Mann. Enum. Bupr. 110.

Agrilus aurolineatus Gory, Mon. Bupr. 4, 248, tab. 41, f. 241.

From Maine to Louisiana, and the Rocky Mountains.

B—e.

12. A. granulatus, æneus, granulatus, pube alba brevissima pruinosus, capite postice sulcato, thorace subcanaliculato bifoveato, lateribus impressis postice breviter sinuatis, antice latiore, angulis posticis acute breviter carinatis, elytris costa discoidali postice abbreviata, fovea basali maculisque duabus subsuturalibus albo-pubescentibus, apice subtiliter serratis rotundatis; subtus versus latera magis pubescente, abdomine maculis marginalibus albis. Long. ·35.

Say, Trans. Am. Phil. Soc. 6, 162.

Buprestis granulata Say, Journ. Acad. Nat. Sc. Phila., 3, 162.

One specimen, Kansas: closely related to the succeeding species, but is easily known by the more finely serrate obtusely rounded tips of the elytra.

13. A. quadriguttatus, æneus, obscurus sæpe subolivaceus, granulatus, pube brevissima pruinosus, capite postice subsulcato, thorace basi medio impresso, disco bifoveato, lateribus impressis late rotundatis, antice paulo latiore, angulis posticis acute carinatis, elytra costa discoidali postice obliterata, fovea basali maculisque duabus subsuturalibus albo-pubescentibus, apice fortius serratis et singulatim acute acuminatis; abdominis lateribus maculis albo-pubescentibus. Long. ·35—·39.

Gory, Mon. Bupr. 4, 228, tab. 38, f. 219.

Middle, Southern and Western States. Sufficiently distinct from the preceding by the elytra, more gradually narrowed behind and acuminate at tip, and by the thorax not being sinuate on the sides near the base.

14. A. subfasciatus, æneus, granulatus, pube brevissima pruinosus, capite virescente, postice vix sulcato, thorace medio obsolete biimpresso, lateribus impressis late rotundatis, antice haud latiore, angulis posticis longe carinatis, elytris costa discoidali postice obsoleta, fovea basali, macula antica, fasciisque duabus ad medium et pone medium pubescentibus, fascia intermedia obscure purpurea, apice serrulatis obtuse rotundatis. Long. ·2.

One specimen, Illinois, Mr. Willcox. Differs from the next, not only by the sides of

the thorax being rounded, but by having pubescent spots outside of the discoidal costa, thus forming transverse bands.

15. A. fallax, obscure æneus, granulatus, capite tenuiter canaliculato virescente, thorace vage canaliculato, latitudine haud breviore, lateribus impressis vix rotundatis postice subsinuatis, margine superiore antice duplici, angulis posticis longe carinatis, elytris costa discoidali prope apicem obsoleta, fovea basali maculisque duabus subsuturalibus pubescentibus, apice serrulatis rotundatis. Long. ·23.

Say, Trans. Am. Phil. Soc. 6, 163.

Agrilus impressipennis Uhler, Proc. Acad. Nat. Sc. 7, 416.

Middle and Western States. The lateral margin of the thorax diverges into two as usual, but the upper one of these is accompanied by a fine approximate raised line from the middle to the anterior angle: a slight vestige of a similar line very near the anterior angle is seen in A. subfasciatus, but is entirely wanting in the next.

A. zemes *Gory*, Mon. Bupr. 4, 234, tab. 39, f. 225, is perhaps a variety of this species, in which the basal and middle pubescent spots are wanting, but the head is mentioned in the description as being not impressed.

16. A. interruptus, nigro-æneus, granulatus, capite postice leviter sulcato, thorace vage canaliculato, latitudine haud breviore, lateribus impressis rectis, angulis posticis longe carinatis, elytris costa discoidali postice obsoleta, fovea basali, lineola ante medium maculaque postica subsuturali pubescentibus, altera externa ad medium sæpe deficiente, apice serratis rotundatis. Long. ·24—·32.

Southern and Western States. Sufficiently distinct from the preceding by the simple superior thoracic margin: the pubescent line of the elytra extends from the basal fifth to the middle; sometimes it is by abrasion divided into two spots: a little behind its termination there is a small external pubescent spot, to be seen in well preserved specimens. The sides beneath are pubescent.

A. obsoleto-guttatus *Gory*, Mon. Bupr. 4, 256, tab. 43, f. 249, is perhaps this species, but the description is somewhat indefinite, and the figure gives but little assistance in determining it.

17. A. subcinctus, obscure æneus, capite sulcato, thorace rugose punctato canaliculato, lateribus subito depressis, angulis posticis acutis planis, basi depresso, elytris fortiter granulatis, impressis, spatiis pubescentibus variegatis, sutura elevata. Long. ·12—·15.

Gory, Mon. Buprest. 4, 248, tab. 42, 245.

New York; rare. Resembles at first sight A. subfasciatus, but is at once distinguished by the sulcate head, and flat thoracic angles.

B—f.

18. A. latebrus, obscure cyaneus vel nigro-viridis, granulatus, capite postice modice sulcato, thorace canaliculato, antice posticeque impresso, lateribus profunde impresso maculaque parva albo-pubescente ornato, angulis posticis subcarinatis; abdominis lateribus pleurisque maculis albo-pubescentibus signatis. Long. ·31—·44.

Laporte and Gory, Mon. Bupr. 2, 38, tab. 9, f. 50.

Agrilus acutipennis Mann. Enum. Bupr. 109: Gory, Mon. Bupr. 4, 225, tab. 37, f. 216.

Agrilus quadriimpressus Ziegler, Proc. Acad. Nat. Sc. 2, 267.

Middle and Southern States, Kansas.

19. A. torpidus, obscurus, ænescens, capite plano pubescente confertim punctato, postice canaliculato, thorace rugose punctato, dorso late sulcato, lateribus late rotundatis oblique impressis, angulis posticis longe carinatis, elytris dense subtilius granulatis, apice angustius rotundatis, serratis. Long. ·37.

Lake Superior and Illinois. The elytra have a very faint discoidal costa, but hardly so obvious as to attract attention. This species is to be distinguished from the next two species by the pubescent front, and strongly carinate thoracic angles.

20. A. anxius, obscurus, ænescens, vel virescens, capite planiusculo, vix pubescente confertim punctato, postice canaliculato, thorace rugose punctato, dorso late sulcato, et bifoveato, lateribus rotundatis impressis, angulis posticis vix obsolete carinatis, elytris dense subtilius granulatis, apice serratis obtuse rotundatis, et brevissime acuminatis. Long. ·35—·41.

Gory, Mon. Bupr. 4, 226, tab. 37, f. 217.

One specimen from Massachusetts, Dr. Harris; another larger specimen in the collection of Mr. Ulke. Differs from the next species by the longitudinal furrow of the head being longer and deeper, and by the posterior thoracic angles being less distinctly carinate; the elytra have a very faint discoidal costa, they are less narrowed behind, the tip is more broadly rounded, with a very short prominent point at the middle; the head of the smaller specimen is tinged with purple, and the thorax is more brassy than the elytra.

21. A. gravis, obscurus, supra subplumbeus, capite planiusculo, vix pubescente, confertim punctato, postice canaliculato antice vage transversim impresso, thorace rugose punctato, dorso late sulcato, et bifoveato, lateribus rotundatis impressis, angulis posticis obtuse carinatis, elytris dense subtilius granulatis, apice serratis obtuse rotundatis. Long. ·37—·40.

Lake Superior and New York. This and the three preceding species, are to be distinguished from the next two, by the sides of the thorax being strongly impressed, and the head more or less channeled; the characters above given will separate each from the others.

22. A. plumbeus, præcipue plumbeo-æneus, obscurus, capite plano, vix pubescente, confertim punctato postice haud vel vix canaliculato, thorace rugose punctato antice latiore, lateribus rotundatis postice subsinuatis vix impressis, angulis posticis breviter carinatis, transversim vage impresso, elytris dense subtilius granulatis, apice obtuse rotundatis serratis. Long. ·27—·37.

Middle and Western States, and Lake Superior; abundant. An easily distinguished species, varying somewhat in colour and in the impressions of the thorax; the latter is sometimes vaguely channeled, and nearly always has a faint transverse impression about the middle; the concave margin is narrower than in the preceding species, owing to the less development of the lateral impression.

23. A. muticus, cyaneo-plumbeus, obscurus, capite canaliculato, vix pubescente, confertim punctato, thorace rugose punctato, dorso pone medium sulcato, lateribus subrectis postice subsinuatis anguste impressis, angulis posticis haud alte carinatis, elytris dense subtilius granulatis, apice haud serratis, rotundatis, sutura paulo prolongata obtusa, scutello plano. Long. ·33.

Lec. Proc. Acad. Nat. Sc. Philad. 1858, 70.

One specimen collected in Texas by H. Haldeman, Esq. Differs from all the allied species, not only by the elytra being not serrate, but by the tips being rounded only from the outside, so as to leave the suture prominent, though obtuse.

24. A. macer, valde elongatus, cupreo-æneus, capite dense punctato, vix pubescente late canaliculato, thorace rugoso quadrato, lateribus rectis profunde impressis, angulis posticis carinatis, elytris costa discoidali granulatis, apice fortius serratis, anguste rotundatis et acuminatis, scutello impresso haud carinato. Long. ·35.

Lec. Proc. Acad. Nat. Sc. Philad. 1858, 70.

Eagle Pass, Texas, Mr. Schott, one specimen. The elytral costa is distinct and extends to the tip.

25. A. cupreolus, elongatus, æneo-cupreus, capite dense punctato, postice breviter canaliculato, thorace latitudine breviore, lateribus late rotundatis, vage canaliculato, oblique transversim impresso, angulis posticis carinatis, elytris juxta suturam late sulcatis, antice sat fortiter postice subtiliter granulatis, apice serratis anguste rotundatis. Long. ·37.

One specimen, probably from Kansas. The discoidal costa is very obtuse, and is rather produced by a shallow broad subsutural furrow than by a distinct elevation; the under surface is more pruinose than usual with short white pubescence.

26. A. obolinus, minus elongatus, æneo-cupreus, capite fortiter punctato, profunde sulcato, thorace latitudine breviore, antice magis convexo, late canaliculato, lateribus subrotundatis profunde impressis, angulis posticis carinatis, elytris costa dorsali obsoleta, antice fortius postice subtilius granulatis, apice serratis obtuse rotundatis, scutello plano. Long. ·34.

One specimen from Kansas. Differs from all the other species known to me except A. macer and muticus, by the scutel being destitute of a transverse carina. The thorax is not wider before the base, and is only slightly rounded on the sides.

27. A. politus, purpureus, cupreus, aureo-cupreus vel obscure æneus subnitidus, capite dense punctato, vage bifoveato, postice subcanaliculato, thorace latitudine breviore, ante basin latiore, lateribus rotundatis anguste impressis postice subsinuatis, vage canaliculato et impresso, angulis posticis carinatis, elytris sat fortiter granulatis, apice serratis rotundatis. Long. ·25—·33.

Say, Trans. Am. Phil. Soc. 6, 162.

Buprestis polita Say, Ann. Lyc. Nat. His. New York, 1, 249.

From Maine to Kansas; not rare. The elytra are gradually obliquely narrowed behind, so as to appear slightly prolonged, and are well rounded at the tip; the front is frequently varied with green; between the eyes are two shallow round impressions. I have one specimen in which the head and thorax are dark brassy and the elytra blackish green.

28. A. desertus, æneus, subnitidus, capite dense punctato, postice sulcato thorace latitudine breviore, postice canaliculato, ante basin paulo latiore, lateribus oblique late rotundatis oblique profunde impressis, angulis posticis carinatis, elytris sat fortiter dense granulatis, apice serratis roundatis. Long. ·24.

One specimen found at the Junction of the Colorado and Gila Rivers, California. Closely resembles the preceding, but the thorax is more deeply impressed on the sides; the elytra are more densely granulate, less prolonged and more obtusely rounded at the apex, and the occiput is more densely impressed.

29. A. puncticeps, obscurus æneescens, elongatus, capite pubescente medio fortiter haud confluenter punctato, occipite paulo canaliculato, thorace latitudine haud breviore dorso biimpresso, lateribus subrectis fortiter impressis, basi bifoveato, angulis posticis longe carinatis, elytris sat fortiter dense granulatis, sub-unicostatis, apice subserratis rotundatis. Long. ·20—·25.

? *Buprestis geminata* Say, Journ. Acad. Nat. Sc. 3, 163.

? *Agrilus geminatus* Say, Trans. Am. Phil. Soc. 6, 162.

? *Agrilus nigricans* Gory, Mon. Bupr. 4, 257, tab. 43, f. 250.

Middle and Southern States. In this and the species below described, the base of the thorax, inside of the carina, is deeply foveate, so as to make the basal carina very acute; the carina itself is about two-fifths the length of the thorax. The punctures of the middle of the head are large and not close, the occiput is rugous.

The descriptions of Mr. Gory do not apply with such precision that I am altogether free from hesitation in using his names for any of the smaller species known to me, and unfortunately his figures do not exhibit any distinguishing character.

30. A. cephalicus, obscurus, æneescens, capite cupreo, haud pubescente fortiter haud confluenter punctato, sat profunde canaliculato, thorace latitudine haud breviore, dorso canaliculato et biimpresso, lateribus subrectis fortiter impressis, basi bifoveato, angulis posticis oblique carinatis, elytris sat fortiter dense granulatis, subunicostatis, apice subserratis rotundatis. Long. ·18—·25.

Middle States and Lake Superior. A species very similar to A. puncticeps, but differing by the head being deeply channeled, with the sides convex; the groove widens and becomes shallow on the front, so as to produce a triangular depressed space; the carinæ of the posterior angles of the thorax are more oblique, and shorter, but in this respect, as well as in the pubescence of the front there is not a precise accordance between the specimens referred by me to A. puncticeps, and it is possible that with increased material there will be found in it representatives of two or more species.

31. A. egenus, obscurus, æneescens, capite viridi, pubescente, granulato-punctato, occipite paulo canaliculato, thorace latitudine haud breviore, lateribus late rotundatis impressis, angulis posticis carinatis, basi bifoveato, elytris fortiter dense granulatis, subunicostatis, apice singulatim rotundatis serrulatis. Long. ·17—·21.

? *Agrilus egenus* Gory, Mon. Bupr. 4, 258, tab. 43, f. 251.

Middle States: a species also closely resembling the two preceding ones, but differing

by the head, which is green, and covered with a tolerably coarse punctuation, having the appearance of granulation. I have for this reason considered it as Mr. Gory's species, though his expression "ecusson très-petit" leaves me in doubt regarding the justice of the determination; after careful comparison, I can perceive no difference between the scutellum of this and several other species which I have placed near it. The carinæ of the posterior angles of the thorax are one third the length of the thorax and oblique upwards.

32. A. lacustris, fusco-æneus, cinerascens, capite convexiusculo, dense fortiter punctato, subcanaliculato, thorace fortius rugoso, latitudine haud breviore, lateribus rectis vix impressis, angulis posticis carinis parum elevatis, basi bifoveato, elytris fortius dense granulatis, apice rotundatis serratis. Long. ·20—·23.

Mas segmento ventrali ultimo truncato-emarginato apice hirto.

Femina segmento ventrali ultimo apice rotundato.

Lake Superior, at Lapointe. Readily recognised by the almost entire absence of the lateral impressions of the thorax.

The following species are unknown, or not identified with certainty.

A. vittaticollis Randall, Bost. Journ. Nat. His. 2, 38. *A. frenatus* Gory, Mon. Bupr. 4, 139, tab. 40, f. 231.

A. zemes Gory, vide No. 15.

A. obsoletoguttatus Gory, vide No. 16.

A. nigricans Gory, vide No. 29.

A. virens Gory, vide No. 8.

A. lateralis Say, Trans. Am. Phil. Soc. 6, 162: *Bupr. lateralis* Say, Journ. Acad. Nat. Sc. Phil. 3, 160.

A. putillus Say, Trans. Am. Phil. Soc. 6, 162.

A. geminatus Say, Trans. Am. Phil. Soc. 6, 162: *Bupr. geminata* Say, Journ. Acad. Nat. Sc. Phila. 3, 163; vide No. 29.

GROUP VII.

We have here very small species, usually of a broad ovate form, though rarely sublinear, in which the antennæ are inserted in large cavities narrowing the epistoma, and frequently received in deep groves extending below the eyes on to the under surface of the thorax. The front is strongly inflexed, and the mouth is applied to the prosternum. The mentum is large, triangular and entirely corneous. The prosternum is variable in form, being either pointed behind, and not angulated on the sides; deeply cleft; or broad and truncate. The mesosternum is very small, with the portions widely separated and sometimes hardly visible. The scutellum is triangular, and sometimes very large: the thorax is more or less lobed at the base. The legs are capable of being applied closely to the body, the tibiæ are sometimes sulcate for the reception of the tarsi, which are always

very short; the ungues are strongly toothed. Our species have been divided into three genera, which have, however, been reunited by Lacordaire into a single genus, distinguished by having the antennæ received in grooves.

Brachys Solier.

The species of this genus form several very distinct groups, which I should consider as genera, but that Lacordaire states that they merge imperceptibly together. Those found in our territories may be thus arranged.

A. Corpus elongatum, prosternum angustum,	(Taphrocerus *Sol.*) - - - -	Sp. 1.
B. Corpus ovatum, prosternum postice fissum,	(Brachys *Sol.*) - - - -	Sp. 2—6.
C. Corpus ovatum, prosternum latum integrum	- - - - - -	Sp. 7
D. Corpus triangulare, prosternum latissimum, tibiæ dilatatæ,	(Metonius *Say*, Pachyscelis *Sol.*)	Sp. 8—9.

A.

1. B. gracilis, elongata, æneo-nigra, capite late excavato, thorace inæquali, elytris antice seriatim punctatis, guttis nigro-æneis fasciisque vagis parce albo-pubescentibus sæpe ornatis; ano rotundato, haud serrato, segmento ventrali ultimo sulco marginali circumducto. Long. ·14—·21.

Trachys gracilis Say, Ann. Lyc. Nat. Hist. New York, 1, 253.

Aphanisticus gracilis Say, Trans. Am. Phil. Soc. 6, 165.

Brachys (*Taphrocerus*) *alboguttata* Mann. Enum. Bupr. 120; Laporte & Gory, Mon. Bupr. 2, tab. 1, f. 1.

Middle and Southern States.

B.

2. B. ovata, antice triangularis obtusa, postice sensim angustata, ænea, capite valde excavato, thoraceque inæquali fulvo-pubescentibus, elytris parce irregulariter punctatis, fasciis albo fulvoque pubescentibus sinuatis ornatis, costa angusta versus latera lineisque discoidalibus obsoletis instructis; ano late truncato, pectinato, segmento ventrali ultimo sulco ambiente, maris postice emarginato, longe ciliato, feminæ truncato. Long. ·19—·25.

Buprestis ovata Weber Obs. Ent. 76: Herbst, Käfer, 9, 245, tab. 156, f. 1.

Trachys tesselata Fabr. Syst. El. 2, 218.

Brachys aurulenta Kirby, Fauna Bor. Am. 162.

Brachys molesta Gory, Mon. Bupr. 4, 332, tab. 56, f. 325.

Brachys tesselata Laporte & Gory, Mon. Bupr. 2, 3, tab. 1, f. 2.

Middle, Southern and Western States. The last synonym belongs to the smaller variety.

3. B. lugubris, antice triangularis obtusa, postice sensim angustata, supra nigra, capite valde excavato, thoraceque inæquali parce albo-pilosis, elytris vage punctatis, fasciis sinuatis albo-pilosis, costa angusta versus latera instructis; ano late truncato, subtiliter pectinato, segmento ventrali ultimo sulco marginali ambiente, maris emarginato ciliato, feminæ truncato. Long. ·21—·25.

Middle and Southern States. Only differs from the preceding by the pubescence being entirely white, and the tip of the abdomen more finely pectinate: the body is perhaps a little less attenuated behind, and more rounded.

4. B. lævicauda, antice triangularis obtusa, postice sensim angustata, supra nigra, capite valde excavato, thoraceque inæquali parce fulvo pilosis, elytris vage punctatis, faciis sinuatis fulvo alboque pilosis ornatis, costa angusta versus latera instructis; ano late truncato, vix subtiliter pectinato, segmento ventrali ultimo sulco marginali ambiente. Long. ·19.

One specimen, Pennsylvania. Differs from the two preceding by the tip of the abdomen being scarcely at all pectinate; the posterior band of white hair is also broader and more oblique.

5. B. terminans, antice triangularis obtusa, postice sensim angustata, supra nigro-ænea, capite valde excavato, thoraceque inæquali fulvo pilosis, elytris vage punctatis, parce fulvo-pilosis, fascia lata ante apicem fulvo-pilosa, costa angusta versus latera instructis, ano rotundato subtiliter pectinato, segmento ventrali ultimo sulco marginali ambiente. Long. ·17—·15.

Laporte & Gory, Mon. Bupr. 2, 3, tab. 1, f. 3.

Trachys terminans Fabr. Syst. El. 2, 219.

Brachys ærosa Mels. Proc. Acad. Nat. Sc. Phila. 2, 148.

Middle and Southern States to Kansas.

6. B. æruginosa, antice triangularis obtusa, postice sensim angustata, supra ænea, capite valde excavato, thoraceque inæquali parce fulvo-pilosis, elytris vage punctatis, fasciis transversis fulvo-pilosis ornatis, costa angusta versus latera instructis; ano subrotundato, pectinato, segmento ventrali ultimo sulco marginali ambiente. Long. ·13—·15.

Gory, Mon. Bupr. 4, 335, tab. 56, 329.

Middle and Southern States; rare. The description of Gory does not mention the most peculiar characters of this species, which only differs from B. tesselata by having no white hairs intermixed with the fulvous ones, by the smaller size, and by the less distinctly truncate tip of the abdomen; the posterior elytral fascia is somewhat farther removed from the apex.

C.

7. B. carbonata, antice triangularis obtusa, postice sensim rotundatim angustata, nigra nitida glabra, capite antice canaliculato, thorace convexo, lateribus et basi subito depresso, elytris antice vage punctatis, basi profunde lateribus modice impressis; ano rotundato, haud serrato, abdomine segmentis tribus posticis sulco marginali ambiente, prosterno grosse punctato. Long. ·14.

One specimen, Louisiana, Mr. Guex. Of the size of the preceding, but more rounded behind; shining black; head convex behind, channeled in front. Thorax more than twice as wide as long, broadly rounded on the sides, disc very convex, sides and base suddenly depressed, posterior angles slightly prolonged acute: base sinuate, middle lobe broadly truncate: scutellum triangular, large. Elytra as wide as the base of the thorax, sides straight for two-thirds the length, then rounded obliquely to the tip; a few scattered punctures are seen towards the base, which is very deeply impressed; a lateral impression before the middle extends nearly to the humerus, which is much elevated. Abdo-

men with the last three segments margined with a fine lateral furrow; the tip is rounded, not serrate. Prosternum triangular, broad, grossly punctured: metasternum deeply emarginate. Tibiæ not visible.

D.

8. B. purpurea, brevis triangularis, nigra, capite subtilius canaliculato, thorace versus angulos posticos vage punctato vix depresso, elytris nigro-cyaneis, lateribus antice fortiter impressis, antice seriatim punctatis, fascia postica obliqua guttisque nonnullis albo-pilosis. Long. ·14.

Metonius purpureus Say, Trans. Am. Phil. Soc. 6, 164.

Brachys americana Gory, Mon. Bupr. 4, 346, tab. 58, f. 343.

Middle and Western States; rare. In this and the next species the scutellum is very large, the prosternum very broad, almost truncate behind, the tibiæ flattened and dilated, and the entire abdomen surrounded with a deep marginal groove: the tip is rounded, not serrate.

9. B. lævigata, late ovata, nigra, capite grosse parce punctato, canaliculato, thorace lateribus postice subito depressis obsolete punctatis, elytris lateribus antice valde impressis, antice fere irregulariter punctatis. Long. ·10—·12.

Trachys ovata||Say, Ann. Lyc. Nat. Hist. New York, 1, 252.

Trachys lævigata Say, Trans. Am. Phil. Soc. 6, 164.

Metonius ovatus Say, Trans. Am. Phil. Soc. 6, 164.

Brachys punctata Gory, Mon. Bupr. 4, 347, tab. 59, f. 344.

Middle and Southern States to Kansas. Not so broad as the preceding, less attenuated behind, with the sides of the elytra more rounded.

GROUP VIII.

I have placed in a separate group a very small species, which differs by many characters detailed below from those which precede. The body is cylindrical, the antennæ inserted in large cavities, by which the epistoma is narrowed, but does not enlarge again distinctly in front as in the three preceding groups. The mouth is inferior, not applied to the prosternum; the front is vertical, slightly convex; the mentum large, corneous, triangular. The prosternum is broad, truncate both before and behind: the mesosternum not visible. The scutellum is triangular and small. The thorax is truncate at base. The legs are not contractile, the tarsi moderately short, with the membranous lobes large; the ungues are broadly toothed.

HAPLOSTETHUS *Lec.*

Antennæ liberæ, foveis insertæ, articulis 1 et 3 crassis, 3io angusto; 4—10 triangularibus, 11mo ovali, capite thoraceque haud breviores. Caput rotundatum, ore inferno, labro transverso, palpis brevibus crassiusculis, mento magno triangulari toto corneo, sub oculos late sulcatum. Thorax transversus, convexus, basi truncatus, lateribus rotundatis, margine laterali duplici, subtus haud sulcatus: prosternum latum, antice posticeque truncatum. Mesosternum haud conspicuum; metasternum prosterno arcte applicatum. Elytra thorace angustiora cylindrica,

postice obtusa, basi profunde transversim impressa: scutellum parvum triangulare. Pedes haud retractiles, tibiis angustis, tarsis tibiis duplo brevioribus articulis 1—4 subtus longe lobatis, 5to longiore tenui, unguiculis haud connatis, basi late obtuse dentatis. Abdomen segmentis 1 et 2 sutura obsoleta, ultimo late rotundato.

This genus is represented by a single species, the smallest Buprestide known to me.

1. H. subcyaneus, cylindricus, niger nitidus, glaber, haud dense punctatus, capite canaliculato, thorace latitudine paulo breviore, convexo, lateribus valde rotundatis, elytris basi fortiter transversim impressis, lateribus pone humeros foveatis, thorace paulo angustioribus, nigro-cyaneis, apice obtuse rotundatis. Long. ·08—·10. Tab. XII., fig. 8.

Middle, Southern and Western States; on leaves or flowers, captured in the sweeping net; rare. The body is punctured beneath, very much as on the upper surface, but the punctures of the anterior part of the abdomen are a little less impressed. The lateral impression of the elytra behind the humerus is small.

APPENDIX.

Melanophila Esch.

10. M. prasina, latiuscula, supra cyaneo-viridis, dense rugose punctata, brevissime pubescens, thorace latitudine breviore, antrorsum paulo angustato, lateribus late rotundatis, medio obsolete canaliculato, disco cyaneo, lateribus late viridibus, elytris apice subtilissime serrulatis; subtus cupreo-ænea, punctata, breviter cinereo-pubescens. Long. ·43.

San Mateo, California; sent me by Andrew Murray, Esq., of Edinburgh. Of the same form as M. fulvoguttata, but finely pubescent like M. æneola. The fifth ventral segment is subtruncate, with the apical margin depressed.

Acmæodera Esch.

11—12. A. Hepburnii, subcunciformis, obscure ænea, hirta, thorace latitudine duplo breviore, lateribus oblique rotundatis, sat dense punctato, medio triangulariter, versus latera oblique profunde impresso, lateribus postice flavis; elytris striis punctatis, postice et extrorsum impressis, interstitiis uniseriatim punctulatis; margine ante medium, vitta a basi ad medium extensa, cum margine fascia lata connexa, fasciis duabus obliquis posticis, guttaque apicali flavis, postice serratis, conjunctim rotundatis; subtus fortiter punctata, modice pubescens. Long. ·39.

One specimen sent me with the others here described, by Mr. Murray. I have dedicated it to Mr. William Hepburn, of San Francisco, by whom it was collected. It has nearly the form of A. pulchella, but is quite distinct by the above characters. There are two small marginal black dots, the first at the junction of the anterior fascia with the margin, the other in the second fascia.

Chrysobothris Esch.

5—6. C. semisculpta, depressa, minus elongata, obscura, ænescens, capite antice minus dense punctato, cuprascente, thorace antice paulo latiore, lateribus rugose, medio parcius punctato, subcanaliculato, elytris costis solitis interruptis parce punctatis, macula transversa antica, alteraque postica sinuata impressis, sat dense punctatis, serratis singulatim rotundatis; subtus cupreo-ænea, prosterno grossius punctato. Long. ·44.

One female from California, kindly sent to me by Andrew Murray, Esq. Resembles C. femorata, but differs from that and the allied species by the more sparse punctuation of the upper surface, and by the more coarse punctures of the prosternum. The middle smooth line of the latter, frequently obsolete or wanting in C. femorata, is here not visible. The anterior transverse impression of the elytra does not extend within the first elevated line.

11—12. C. contigua, depressa, minus elongata, cupreo-ænea, capite antice minus dense punctato, thorace antice paulo latiore, fortiter punctato, parcius in medio, canaliculato, elytris obscure æneis, costis indistinctis, fortiter punctatis, impressionibus utrinque duabus transversis vagis punctatis spatiisque contiguis parcius punctatis, apice serratis singulatim rotundatis, tibiis intermediis rectis. Long. ·30.

Mas segmento ventrali ultimo breviter emarginato, tibiis anticis paulo curvatis, ultra medium dente interno acuto armatis. Femina latet.

One male from California kindly sent me by Mr. Murray. Readily distinguished by the above characters. The impressions of the elytra are deep but badly defined, and the punctures in them are scarcely more dense than on the general surface towards the base: the portions contiguous to the impressions are very sparsely punctured. The prosternum is coarsely and tolerably densely punctured and slightly hairy.

13—14. C. californica, depressa, obscure cupreo-ænea, capite antice dense punctato, thorace lateribus parallelis utrinque incurvis, rude punctato, cicatricoso, dorso profunde sulcato, costa utrinque lata lævi nitida calloque versus latera notato, elytris costis solitis elevatis lævibus nitidis interruptis transversim subconnexis, spatiis depressis fortiter dense punctatis, subtiliter serratis apice singulatim rotundatis; subtus fortiter punctata, prosterno hirto. Long. ·70.

Mas segmento ventrali ultimo profunde emarginato, tibiis anticis ad apicem introrsum subito dilatatis et sulcatis. Femina latet.

One specimen from California: Mr. Murray. A fine species allied to C. trinervia, but abundantly distinct by its larger size, and by the less frequent connexions between the smooth elevations of the elytra.

18. C. deleta, longiuscula, fusco-ænea, capite paulo pubescente, haud dense punctato vage impresso, thorace brevi, punctato, et transversim rugoso, paulo pubescente, lateribus valde rotundatis, elytris rugose punctatis, breviter pubescentibus, costis angustis, impressione ad medium foveisque posticis duabus vix distinctis, subtiliter serratis, apice singulatim rotundatis; subtus cupreo-ænea, punctata pubescens, prosterno fortiter punctato. Long. ·31.

One female from California: Mr. Murray. Very distinct by the short sparse white pubescence of the upper surface, and the very finely serrate elytra. The ventral segments have the usual triangular smooth spaces, but their angles are not prominent; the last segment is rounded at the tip, and its lateral serration is very fine.

Several species mentioned by the older authors, as coming from North America, are not noticed in the preceding pages, because they evidently do not belong to the fauna of the United States.

INDEX OF SPECIES.

1. Cyascutus planicosta Lec.
2. Thrincopyge alacris Lec.
3. Acmaeodera [illegible] Lec.
4. Acmaeodera haemorrhoa Lec.
5. [illegible] comata Lec.
6. Acmaeodera gibbula Lec.
7. [illegible]
8. Haplostethus [illegible]

ARTICLE XVII.

Analytic Orthography; an Investigation of the Sounds of the Voice, and their Alphabetic Notation. By S. S. Haldeman. Read Oct. 7th, 1859.

CHAPTER I.

COMPARATIVE Grammar cannot acquire a scientific shape until it discards the pedantic fetters of orthography, and writes all languages according to one system; for things of a kind admit of a just comparison only when compared by the same standard. In this respect, philology is in its infancy, and we place difficulties where none are to be found in nature.—*Rapp,* Grundrisz der Grammatik des Indisch-europäischen Sprachstammes, 1855, p. viii.

§ 1. *The present tendency of science* is to adopt standards of universal application, and it is usual for learned societies and associations, to have a permanent committee of research, consultation, and correspondence, with a view to bring about a uniformity of weights, measures, and coinage.

2. *The advance of linguistic science* demands a uniform nomenclature and notation for the phases of speech, so that the same syllable may be written in the same manner, wherever there is occasion to use it, just as every known plant and insect is recognised by a uniform Latin name among all who are familiar with botany and entomology.

3. *Although the want of a uniform mode* of representing languages is felt as an urgent necessity, they have not been provided with a letter for each sound; whilst chemistry, (which is not studied by one in a thousand,) has a perfect notation, an alphabet of dotted or marked letters, to represent some sixty elements; and, as it were, spell all their ascertained combinations.

4. *Berzelius did not base his symbols* on his native Swedish, but upon Latin,* without even looking at the inconsistent and cumbersome notation which his predecessors of the last century had used, and which may be seen in their books, or in the Encyclopædia Britannica, as late as the year 1798.

* "Berzelius has properly selected them from Latin names, as being known to all civilized nations."—*Turner's Chemistry.*

5. *Alphabets of hundreds of characters* have been cut for Arabic, Sanscrit, and Greek;* the Greek vowel *iota* requires the fifteen types ι, ί, ὶ, ἰ, ἱ, ἷ, ἴ, ἵ, ἶ, ἳ, ἲ, ἷ, ἵ, ἶ, ἴ, the general alphabet proposed by S'uñic', (*Schunjitsch* in German letters,) requires seventy-two vowel modifications; astronomers and mathematicians have a sufficient typography, and the complicated notation of modern music can be set up in detached types.

6. *The chemic alphabet* came from the hand of a philosopher; English writing has been controlled by the literary and superficial, as distinguished from the scientific public; the alchemists rather than the chemists—astrologers rather than astronomers—linguists like Trench, rather than philologists like Rapp, who "settle" questions in spelling, pronunciation, and grammar, according to English analogies, without knowing what these analogies are. †

6 *a*. *Goold Brown writes* a ponderous "Grammar of English Grammars," after consulting about four hundred authorities, but instead of producing a cyclopædia on the subject, the work is worthless for deciding questions which depend upon general principles. With him, (and probably nine-tenths of his four hundred grammarians,) *awe* is a tripthong, beginning with *a;* and with Trench, (in lectures, and therefore clear of spelling,) "*ant* and *emmet* were originally different spellings of the same word," (as "*gaol*" and "*jail*," or "*plough*" and "*plow*" are at present,) but he does not tell us whether the "same word" that "ant" spelt, was *emmet*, or the reverse, "emmet" spelling *ant*.‡

6 *b*. *A college student asserts*, in a published communication, that one of his professors

* "Where ligatures and abbreviations abound . . . 750 boxes are required for the different sorts of a fount of Greek . . . It must, however, be observed, that almost 300 of these sorts are the same, and have no other difference than that of being kerned on their hind side; for we remember to have seen Greek with capitals kerned on both sides."—Printers' Grammar, 1797, p. 242.

† *This Essay owes its form and matter* to the following circumstances. In the year 1857, Sir Wm. C. Trevelyan, A. M. (Oxford,) of Wallington, Newcastle-on-Tyne, offered two prizes for essays on a Reform in the Spelling of the English Language, to contain, among other features, an Analysis of the System of Articulate Sounds—an Exposition of those occurring in English—and an Alphabetic Notation, in which "as few new types as possible should be admitted." The last requisition has, in a few cases, resulted in a double notation, one of which represents the author's preference in a new form of type, the other being a form in use, but not approved. The investigation was made from a natural history point of view, and the results are here presented. A Report is yet to be made to the American Association for the Advancement of Science on the Subject of an Alphabetic Notation for exotic Languages. Suggestions and criticisms are solicited towards this end, to be addressed to the author at Columbia, Pennsylvania.

‡ Similarly Webster, the chief of English lexicographers—"nations differ in the *orthography* of some initial sounds. . . . Thus the Spanish has *llamar* for the Latin *clamo*." This is a difference of "orthography" in the same sense that English "knee" differs from the Saxon "knee." People who hold such views must consider *tear tear, sow sow, bow bow, wind wind, wound wound*, as identic, because they do not "differ in the orthography;" whilst *convey inveigh, receipt deceit, noun renown, sprite sprightly, expatiate spacious*, presis*tance -ency*, cons*istent* re*sistant*, must be considered as wanting identity.

says pronun-si-ation, another pronun-shi-ation, and there is probably no orthoepist who has determined the theoretic form by investigating the laws of *speech* which govern such words. Richardson, Eng. Dict. Prelim. Essay, § II. p. 17, tries to split a simple element (*ng* in *sing*,) in citing Gothic "ga-g-gan" Anglosaxon "ga-n-gan" *to go;* Regnier* does the same for the German past participle "ge-sun-gen," and J. E. Worcester also, in the word "haidin'gerite" for hai'ding-erite.

7. *In Professor Fowler's English Language*, (chiefly Latham's Book,) and under the head, "Combinations not in the Language," he states, that English has "but few rough-breathing or *true aspirates* in comparison with the *Greek*, and those mostly confined to compound words like *off-hand, with-hold, knife-handle.*" Such combinations as *th-h* and *f-h* are not Greek, nor do *th-h* constitute *an* aspirate. This statement is probably due to a misunderstanding of a false view of Greek φ, (and why not of θ, χ also?) confidently given in Donaldson's New Cratylus. The uneducated sometimes assert, that there are but few vowels in Arabic and Hebrew; and Professor Fowler seems to think it remarkable, that there are syllables "in Choctaw like *yvmmak*, in the Welsh like *yspryd*. . . . Combinations like these are altogether undesirable." This is a very roundabout, but strictly literary way of saying that he considers the English syllables *hum* and *us* objectionable, since but few of his readers could know the pronunciation of the words quoted. His view of quantity, (which is subject to the same phases in all languages,) is strangely perverted. "If the quantity of the Syllable be measured, in the Classic mode, not by the length of the Vowel, but by the length of the Syllable taken altogether, *see* in *seeing*, being followed by another vowel, is short." Compare Latin hērōēs and English hērōes, or illēus and illeŭs.

7 *a. In the Latin Grammar* of Prof. C. D. Cleveland, A. M., it is stated that "A letter is a *mark* of a sound," that these *marks* of sound or "Letters, are divided into *vowels* and consonants," and that the *mark* he calls "A vowel, is properly called a simple *sound*." According to this, Comanche has neither vowels nor consonants, French has not a peculiar *u*, *y* is a long "vowel," and *o* is a round one.

7 *b. In one of the widely spread* school books of R. Sullivan, LL. D., T. C. D., it is stated that "A letter is a character or *mark* used in writing words. . . . Letters are divided into vowels and consonants. . . . A *tripthong* is the union of three *vowels* into one *sound*, as *ieu* in ad*ieu*." "In every syllable there must be at least one vowel." It can have but one, and may have none. "Ness denotes the prominent or distinguishing qualities. . . . Ness properly means a promontory." "For the sake of euphony, IN, in com-

* Traité de la Formation des Mots dans la Langue Grecque, Paris, 1855, p. 138.

position, usually assumes the form of the initial letter of the word to which it is prefixed; as in *ig*noble, *ig*norance," &c.

8. *Whilst such literary ideas* have tended to corrupt the judgment of every native investigator of a badly written language, the student in geometry and astronomy is not trammeled with the magic and astrologic value of triangles and squares; the chemist sweeps away the rubbish of alchemy; musicians construct a system adapted to their wants without regard to the features that would render a previous imperfect system unintelligible without special study; mechanics and manufacturers have their standards and gauges; even the cooks of the civilised world have a uniform nomenclature; and in his way Mr. Soyer has a more philosophic mind than Deacon Trench, the modern painter is a better observer than the poet, George Cruikshank a better delineator than Charles Dickens.

9. "*A people will no more quit their alphabet* than they will quit their language."—*Trench.* Yet Anglosaxon, (which will be called *Anglish,* for a reason given in § 255,) and black letter disappeared; old letters were dropped, (as those for the sonant and surd *th*, þ, and the Danish vowel *y*,) improper new ones were introduced, as Belgian (a term used in preference to *Dutch*,) *k, w, v, y, z,* Latin *q, x,* (not used in normal Anglish,) a peculiar unauthorized *j*, probably Norman; and *every one* of these letters, *th, th, k, w, v, y, z, q, x, j,* was ignorantly foisted upon English, by people who had so little idea of spelling, that the same word was often spelt in several ways upon the same page.* Of these ten novelties, one half, (*k, q, x, th, th.*) were unnecessary, and the remainder, (*j, v, w, y, z,*) came in with false powers. Forms of letters have varied, long *s* has disappeared, and ct has replaced a form ct with an arched line of union. Spelling has varied materially and often for the worse, and the modern page differs in the use of capitals and italics.

10. *Duponceau objects* (Tr. Am. Phil. 1818, p. 237) to "the masquerade dress under which men of more fancy than reflection would disguise the immortal thoughts of Milton and Shakespeare, so that the eye would no longer at once recognise them," &c. But this disguise has been already cast over them. Milton was born in 1608, and his Paradise Lost presents a very different appearance from the first edition of 1667. The following specimen of Shakespeare (in modern typography) shows, that (like Duponceau's "vision") his† spellings of 1623 have "melted into Ayre:"

* The following examples are from Holland's Plinie, 1635, some of them from contiguous lines—*we wee, she shee, he hee, pul pull, wil will, ten tenne, sun sunne, moon moone, stars starres, els else, bin beene, physitian physition, whelps whelpes, shels shells, clee clawe, oisters oysters, meremaids mearmaids.* Parkinson) 1640,) has *poppy* and *poppye* in the same line, and Jonstonus (1657,) uses *eels* and *eeles.* Chaucer has *egre eger, malgre maugre, lest list luste, lewed lewde, kneen knene, hackenaie hakeney.*

† "These are not *his* spellings; he edited no play, and the Tempest was not even published in his life time. They are printer's spellings, probably more regular than his." MS. note of A. J. Ellis.

. . . . . into thin Ayre;
And, like the baselesse fabricke of this vision,
The Clowd-capt Towres, the gorgeous Pallaces,
The solemne Temples, the great Globe it selfe,
Yea, all which it inherit, shall dissolue,
And like this insubstantiall Pageant faded,
Leaue not a racke behinde.—*Tempest*, Act 4, Sc. 1, 1623.

11. "*Here then are England and Wales*, with their sixteen millions of people, with nearly *eight millions* unable to write their name, and not less than five millions unable to read their mother tongue."* In the United States, even in the states which supply the education at the expense of the treasury, the number of illiterate people is very large. The time for attending school is limited among the poor, and schools are rare where the population is sparse, so that minds of a high order may remain undeveloped. Energy indeed may overcome great difficulties, but this may form no part of a mind of high generalising and inventive powers.

12. *The millions of freemen* kept in mental and moral darkness, instead of loving an orthography, know not what it is, whilst the great mass of readers despise it;—some thinking it a trick of the schoolmasters to extend the period of tuition—whilst others regard it as a means of separating society into a lettered and an unlettered class.†

13. *A child aged thirteen, who can read*, has within a few days spelt as follows:—b-a-o-t *boat*, (not knowing the position of the "silent" letter,) l-oo-k, l-o-k, *lock*, (putting "*double*" before *o* is not suggestive of a different sound,) m-u-r-o-u-r *mirror*, ("*you*" and "*eye*" are equally unsuggestive of the first vowel of this word,) c-h-i-r *chair*, (saying c-h-ai-r instead of c-h-a-ai-r.)

14. *Among the most mournful* of theatrical scenes, such as are most likely to call up feelings akin to those of the poet who sung—

Srdce moy szarcze ach hui deos sadnissa!
Kard man hiort ag cuige diz sathinassus?

are those in which an illiterate character slowly spells out a letter, commencing "D-ee-r C-u-r," and is greeted with a shout of laughter from people who would spell *cur* (which has a cay sound) with a consonant called *see*, and a vowel called *you*, and then pronounce this s-you-r as *cur*.

* British Q. R. Nov. 1846, Art. VIII., p. 472, quoted in Ellis's Plea, 2d ed. p. 56.

† "It is better for criticism to be modest . . . till the pardonable variety of pronunciation, and the true spelling by the vulgar have satirized into reformation that pen-craft which keeps up the troubles of orthography for no other purpose, as one can divine, than to boast of *a very questionable merit as a criterion of education*."—*Dr. James Rush*, Philosophy of the Human Voice, Philadelphia, 1833, p. 383.

15. *Three millions of people* can support a literature in all its branches, from primers and almanacs to encyclopædias and universal histories. This may be given in round numbers, as the amount of population supporting Danish, Swedish, and modern Greek; and about a million Albanians are divided upon three alphabets, the Italian, Greek, and a native one of 52 characters, more different from the Greek and Italian than these are different from each other. A journal is considered to be well supported when 2,000 copies can be disposed of, and in the Book Trade, works devoted to special branches of knowledge are often printed in editions of 250 copies, not as rarities for bibliomaniacs, but to supply the probable demand.

16. *When more rational modes* of orthography arise, there will therefore be much danger, not from the dearth of books, but from the multiplicity of alphabets which will be proposed—and it is possible that there may be half a dozen in the British Islands, and twice as many on the Vesperian side of the Atlantic.

17. *There is a politic reason* for a reformed orthography. The age demands it, and the population is moving steadily towards it, unconvinced by platitudes on the Study of Words by those who have not exhibited that acquaintance with the science which the discussion of its principles demands. The reform should be undertaken with all the aids that science and scholarship can command. Let the fields of philology, physiology, epigraphy, and living speech be explored, and let an alphabet be erected, so free from those national perversions which national vanity might wish to be legitimate, that no one will have the power to say—"They are only exhibiting the dress of their vernacular,"—"This letter has a purely English power,"—"That is a French corruption."

18. *Let the alphabet be capable of enlargement,* to render it adaptible to all languages, whether English, Italian, or Tahitian, and equally suitable for the dialect of the peasant and the tables of the comparative philologist; and let it not run counter to the great etymologic and metric principle which requires that all records, statements, and comparisons, shall be made in symbols, each of which shall represent the same phenomena.

19. *The great success of phonography* shows that not a single concession which is false in principle, need be made to conciliate English sympathies, (§12,) or to preserve so-called English analogies; and it would be unkind and ungenerous to all nations having the allied pairs of vowels in *they them, marine mariner, he his,* were the attempt made to assign characters to them as diverse as a, e, for the former, and e, i, for the latter. The unlettered five millions *feel the affinity* between the vowels of *break* and *wreck,* who would see no more fitness in the dissimilar forms a, e, than the chemist finds in the cumbersome notation of the alchemists.

20. *It is admitted by Mr. Ellis,* (Plea, 2d ed., 1848, p. 130,) that his English alphabet of 1848 would injure the visible etymological connection between Italian and Latin; "but *we* should as much *injure the visible etymological relation between English and Latin* by any other mode of spelling." But as Italian *is* nearer to Latin than English is, a proper orthography would show it. English has no right to *seem* to have a certain resemblance to Latin which it has not—to pretend, by spelling *secure* with an *e*-character, that it is nearer to the Latin sēcūrŭs than is the Italian *sicuro.* § 256—8.

21. *The English consonant th,* and the vowels in *at, up,* not being Latin sounds, should not be represented by Latin letters, but by new or modified forms, so that the eye could detect strange or unlatin elements in an unlatin language, as readily as the eye detects Polish by its crossed *l,* and distinguishes Portuguese from Spanish by a nasal sign, which also separates Polish from Bohemian, as it should separate French from Italian, to exhibit its affinity with Portuguese.

22. *German should not exhibit* a seeming resemblance to English in *th* for *t* in *theil,* (a part,) a cognate of *deal,* because English *th* is not wanted in German; nor should French have *th* (for Greek theta) in *thême,* where the English are entitled to it. The Welsh, having the *f* sound, should not write *ff* for *f* of the twelfth century, and having English *v* (for which 'w' was used in the twelfth century, and 'u' in the thirteenth) they should not write it with the *f* character—although this is a trifling error compared to that of using the Latin V (*way,* § 106) character for the English *vee* sound. In short, Welsh, German, Latin, English &c. writing should resemble when the words are alike—when different, it should dissemble.

23. *If we can pronounce French and Polish,* we can appreciate the relations between the following pairs, in which the Poles have sought to secure an identity in the *word* rather than in the *sign*:—bécasse, *bekas,* (snipe;) paragraphe, *paragraf;* paralytique, *paralityk;* page, *paz';* bagage, *bagaz';* parasol, *parasol;* parapluie, *parapluj,* (umbrella;) Triest, *Trst;* German *meister,* Polish *majster;* English *Mr.,* Bohemian *mistr.*

24. *A physiological basis* has been advocated, and the alacrity with which the Standard Alphabet of Professor Lepsius, (London, 1855,) has been adopted by various missionary societies, seems to be an evidence in favour of such a basis. Unfortunately, the acknowledged merits of the learned author have caused this work to be adopted without due examination. This "admirable treatise," (p. III. of the preliminary recommendations,) wherein the author "clearly explains the scientific principles," (V.) the result of his "close and profound attention," (VII.) and "Fleiss," (VIII.) or industry; "principles which Professor Lepsius has so ably sketched," (VII.) and which are to diminish "the

difficulties encountered in the *formation of a language* previously unwritten," (VI.)—this treatise, as a System, is unphilosophic, inconsistent, vacillating, and superficial.*

25. *Dr. Lepsius concedes* that an alphabetic system should admit of "reduction and enlargement without alteration in its essential principles." Yet a uniform mode of enlargement is not proposed, and whilst *l* is allowed to represent an aspirate *l*, *n* is not allowed to represent an aspirate *n*, because *l* is "fricative" and *n* "explosive," by a false theory; nor is there a substitute suggested for the forbidden spīrītŭs āspĕr mark. The diacritic marks used are not restricted to particular phases of speech; but, on the contrary, one mark is assigned several heterogeneous values.

26. *Professor Lepsius has not quoted* Mr. Ellis, who is much his superior in this intricate subject, nor Dr. Latham, who would have informed him that a diphthong is not composed of two vowels. Nor has he given the Latin alphabet a critical revision, if we may judge from his notion (p. 41) that the Latin *diphthong* Œ is the German *vowel ö*, and that CŒLUM ends with German *m*, and that this Latin word is, in German letters, kölum, rather than (in Polish notation) kòjlu, or (French) cōylou^{m}.

27. *English spelling has a redeeming feature* to which the late period of its reform gives incalculable value. *Its corruption is so great*, that *any* consistent alphabet would have so many discrepancies from the present one, that the few concessions which the new could make, would be of very little aid to any one already able to read the corrupt one, whilst the drudgery of learning the irregularities of this, would be lessened but little by the form of a phonotypic one previously learned. Hence, as far as English is concerned, the new alphabet might be Greek, Russian, or phonography, because the labour of learning to read a consistent new alphabet is not great.†

28. *The Cherokees, who have a cumbersome* and imperfect syllabary of 85 characters, which must be laboriously written in their printed forms, when advised to adopt the Roman alphabet, express their distrust of ours, stating that the best argument in favor of their own is the fact, that when their children have learnt the characters, they are able to read.

29. *English spelling is so irregular* that any reformed orthography in Roman typography

* See my Report on the Present State of our Knowledge of Linguistic Ethnology, made to the American Association for the Advancement of Science, (Tenth Meeting,) August, 1856.

† The use of a corrupt alphabet induces bad habits in a phonetic one like Greek. A girl of fourteen, who knew the sounds of German and French, learnt the Greek alphabet in one hour, about one-fourth of which was taken up with a work on inscriptions, to account for the writing forms; but when words were to be spelled out, ἦν was converted into English *an;* εἶς (instead of having the initial vowel of *etch*) became *ice;* and to words like κόσμος with the genuine but short vowel of cŏast, that of *cost* was assigned, (for even in the modern tongue, *o* and *ω* have the same quality.) Similarly, several persons have been met with, who read the Spanish article *el* like the first syllable of *alley;* because, Spanish *e* being English *a*, *a-l* must spell *al*.

must present radical differences, because *one* mode of notation must replace *many* modes. Hence if *o* is adopted with its correct power in *host*, the word *lost* must vary from its present form, and nothing in the new can recall old forms like *lore*, *lose*, and the *seven or eight thousand words* spelt with final *e*, which must disappear from the whole, perhaps to be transferred to other words which have been spelt with a different final character. Digraphs being wrong in principle, they should not even be hinted at, as in using a character like ꝏ to recall the old *oo*, which ought not to be recalled intentionally, and for ages to come. Compare door, adore, oar, four; rot, rote, root, groat, slough;* mote, moat; they, met, meet, meat, mete; great, grate; bate, bait; bite, bight; heel, heal, fealty.

30. "*Writers on phonetics* . . . adopt the present letters as far as they go, adding a few new ones to complete the list. They wish to retain the old letters, so that the present generation may be able to read the new way with little trouble. Grave as this consideration may look, it is but a slight one. A man can learn a phonetic alphabet which is altogether new to him, in a few hours; a labor insignificant in an alphabet intended to spread over the world. There is no advantage to the learner, in retaining a letter as to its shape, and changing its character. We may retain the letter e, but *when we restrict it to one of the many sounds it now stands for, we make a new letter of it.* It occasioned me more trouble to remember that a particular sound belongs to the printing a, and another to the written *a*, than to attach those sounds to new characters, because in this latter case the other sounds of the letter a are not constantly occurring to my mind." Condensed from *An Endeavor towards a Universal Alphabet;* by A. D. Sproat, Chillicothe, Ohio, 1857.

31. *English spelling can be reformed thoroughly*, whereas, in Spanish, Italian, and German, the imperfections are fewer, and their removal less imperative. The Italian syllable QUI corresponds with Latin QVI, but Spanish *qui* has *u* silent. Italian uses J nearly in its proper Latin sense, Spanish corrupts it to a guttural aspirate, and uses *y* instead of Latin J; Spanish *ch* is *tsh*, Italian *ch* is *k*, that is, *h* keeps the *cay* pure in Italian, and corrupts it in Spanish. It may be long before such discrepancies are removed.

32. *The English word chew* (tshoo, Walker) would be expressed by *chu* in Spanish, *ciu* in Italian, *tschu* in German, *tchou* in French, *чу* or *muy* in Russian, *czu* in Polish, *csu* in Hungarian, and תשו in Hebrew. The Greek and Latin alphabets are incapable of representing it—for in *tshu*, the *sh* should have their power in *mishap*, and *s* being already an aspirate, it cannot be treated like the lenis *t*, to form *th*. If the English word *favor* were German, it would be spelt *fewer;* and if the Latin COR (heart) were English, it would be spelt *core*, as in fact it is.

* *As words*, 'groat' and 'slough' are unknown to the writer, except the latter as a medical term.

33. *If English spelling had been reformed* earlier, it would have been badly done, by persons ignorant of the bearings of the subject, and before a correct enumeration of the sounds had been made. Now physic^{k}ists like Willis, Herschel and Faber, and philologists of the first class, contribute their stores, based upon a more refined analysis of the operations of speech. Formerly, had there been an educated class, (educated in linguistic science,) this class would have stood aloof until an alphabet as corrupt as the present one would have been fastened upon the language, making English the laughing stock of civilised and savage nations, indirectly checking its influence—cutting off the English people from the antecedents of their language, whether Anglic, classic or C^{k}eltic—depriving them of the incidental etymologic knowledge which is suggested through the eye of a population where information is acquired by reading rather than by conversation—and surrounding them with a literary Chinese wall, not to exclude the barbarians, but to keep them within the circle of their abominations.

34. *If Walker had used a phonetic alphabet* instead of his figured notation, he would have done much towards a reform in spelling; but he would probably have allowed b-a-r to spell *bare* instead of *bar;* n-o-t to spell *not* rather than *note*—sanctioning corruptions which a better educated age might have a difficulty in removing.

35. *Walker's notation is not chronologic,* as in *tar*, which he marks with a_2 instead of a_1, or simply *a*, as *the original power for which the character was made.* A chronologic notation would run something like *fa*$_1$*r*, *a*$_2$*ll*, *wha*$_3$*t*, *fa*$_4$*t*,* *a*$_5$*le*, *fa*$_6$*re*, (French *ê*,) *umbrella*$_7$, *ma*$_8$*ny*, *pla*$_3$*it; mari*$_1$*ne*, *wi*$_2$*n*, *wi*$_3$*ne*, *fi*$_4$*r; Shang-hæ*$_1$, (-high,) *Gœ*$_2$*lic*, *Cœ*$_5$*sar; o*$_1$*we*, *o*$_2$*r*, *ho*$_3$*rror*, *mo*$_4$*ve*, *wo*$_5$*rk.* If, with such a notation, the orthoepists had represented a given sound with the letter having the lowest figure, the tendency would have been from corruption toward purity, and the figured pronunciation would have been a collateral aid to etymology, especially if characters which want the original power in English, had been started without the lower numbers, as in *rhy*$_5$*thm*, (y_1 being the Greek vowel, and y_2 the French i_1,) *rhy*$_4$*me*, *my*$_5$*rrh*, *y*$_6$*ear.*

36. *Mr. Trench uses an argument* which deserves attention.† He considers it an assumption of the spelling reformers "that all men pronounce all words alike, so that whenever they come to spell a word, they will exactly agree as to what the outline of its sound is. Now we are sure men will not do this from the fact that, before there was any fixed

* Mr. Ellis thinks that *arm* had the vowel of *fat* formerly;—that *all* wh*a*t were not early sounds; that within three hundred years, m*a*de l*a*de were m*a*d l*a*d, with the vowel lengthened; and that the historic order of the powers is—*a*rm, f*a*t, *a*ll, wh*a*t, f*a*re, *a*le. Mr. Ellis will present a history of English pronunciation for the last three centuries, in the third edition of his Plea, to be published in the United States.

† *English, Past and Present,* Lecture V., a production which, in sixty years, is likely to be regarded as a curiosity, if we may be allowed to reason from the condition of chemical notation in 1798.

and settled orthography [pronunciation?] in our language, when therefore every body was more or less a phonographer, seeking to write down the word as it sounded *to him,* for" like the Hebrews, Hindoos, Greeks, Latins, Welsh, and Cherokees, "he had no other law to guide him, the variations of spelling were infinite. [*] Take for instance the word *sudden;* which does not seem to promise any great scope for variety."

37. *Certainly not,* if we spell all the variations of *subdan* (with silent *b* as in *sub*—†) to suit the Latin SUBiTANEUS, or conform them to the French *soudain,-e.* He proceeds to cite fourteen spellings, *assuming* that they represented the modern word, and not the lost forms from which our *sudden* is derived. Double forms like *soden* and *suddain,* perhaps of different age and locality, may (apart from the blunder of the double *d*) have been as correct formerly as are now *urban* and *urbane; human* and *humane; travail* and *travel; costume* and *custom; clarify, glory, glare, glair,* and *clear; emmet* and *ant; decking* and *ticking;* or *brest* of Wiclif, Chaucer, Shakespeare, and the lettered vulgar, beside *breast* of those who know not the use of letters, according to Prisc^k^ian's definition.

38. *Granting that these fourteen* spellings stood for the same vocable, having the vowel *up* in the first, and of *end* in the second syllable, these sounds were unprovided with special characters, so that *sud-* might be spelt *sod-,* with *o* in *worth,* or *sodd-, sudd-,* some writing *dd* to shorten the vowel, as we spell *add sad, will wilful.* Thus, *sodain* may have had the vowels of worth and *said*; *sodaine*—

Jelous in honor sodaine and quicke in quarrell.—*As you like it,* 1623.

the *e* of imagin*e*(-ation;) *sodan* the vowel of m*a*ny; *sodayne* that of *says,* (*sayd;*) *sodein-e* that of h*ei*fer; *sodeyn* that of th*ey* pure, or modified as in its derivative th*em,* as silent *b* turns *break* into *wreck.* Other forms would have been justified by fr*ie*nd, j*eo*pardy, d*ea*d, fœtid, g*ue*ss, paneg*y*ric, (*Ellis,* Plea 2d Ed., p. 155,) English being more irregular here than old English, with the difference, that the moderns corrupt a wider field with their irregularities. Abner Kneeland thus answers the foregoing objection.‡

* As in the variations of the Latin word DUO, which have been spelt as in *two, twice, twain, twelve, duodecimo, dodecahedron, dual, deuce, double, doubt, tub, diander, bisect, balance*:—or of GENTĪLIS—*genteel, gentility, gentile, gentle, jaunty;* of which the first, as the oldest and nearest the original, should have had a more etymologic orthography, whilst the last should not have been spelt with *j* and *y.* So Greek varies, as in γίννος, γιννὸς, γινὸς, γῖνος, ὕννος, ἶνος, ἰννός, a *hinny* (*ginnet, jennet.*)

† Here the writer consults Ogilvie's Imperial Dictionary to be assured that there is a word *subtil,* suggested by French and Latin, but he finds only *subtle* and *subtile.* The form attend*ance* caused *the third word* of this essay to be misspelt tend*ancy,* and *gauge* (§ 7) was spelt 'guage' through ignorance of the conventional form. In another place the writer has spelt *privitive* as 'privative.'

‡ A specimen of the American Pronouncing Spelling Book, &c. Philadelphia, 1824. Printed partly in a phonetic alphabet.

39. "*If this system of orthography* should ever be adopted for the language itself, it is recommended that *every author should write as he himself would pronounce;* and then, as it is natural for every one to strive to imitate the best writers and speakers, *in process of time the language would become settled* in a uniform mode of writing and speaking."

40. *It is becoming evident,* that without an orthographic reform, the integrity and universality of the English language will be destroyed, and the arch with which it spans the globe will fall into fragments more heterogeneous than the dialects now current in the British Islands. Webster gives a word *rail*-lery; and eng-*ine* is common in the United States: both being taken from books, and not from speech. This would not have happened if *raillery* had conformed to its analogue *gallery,* and *engine* (Fr. engin) to *virgin.* and *origin.* These are examples of corruption in one direction; in another, chiefly due to the East Indian press, we find a jargon coming into use, and reminding one of the thieves' dialect in London. Thus, an English soldier will "loot the camp," where an American (since the Mexican war) will "vamos the ranch."

41. *The present author* laid an alphabet before a learned society in the year 1844, but withdrew it before it was reported on, because he had a limited knowledge of vocal phenomena, and was not acquainted with the Latin alphabet—a knowledge which must precede every attempt to employ it for phonetic, etymologic, or ethnologic purposes. Since that period, the Greek and Latin alphabets have been studied, but leaving three points still in doubt; namely, whether Greek η had the power of *e* in *they,* (the Latin E,) or in *thêre,* (but accepting the latter, chiefly on the authority of E. A. Sophocles;) next, whether Latin O was German, English, Spanish, and Portuguese *o,* or Italian *o,* (which varies a very little towards *awe;*) and, what was the nature of Latin L, of which the accounts given by the ancient grammarians are unsatisfactory. From philologic considerations, O and L have been assigned their German and English power, which would cause the German word *lob* (praise,) the English word *lobe,* and the first syllable of the Latin LOB-US to be written LOB.

41 *a.* TEN PARADOXES.

1. The letters *c* and *s* never have the power of *sh* in English.

2. In disquisitions upon the elements of speech, the term diphthong is useless.

3. The term *euphony* is useless in etymology. (This view has been anticipated in Prof. Key's paper "On the Misuse of the terms Epenthesis and Euphony." Philological Society's Transactions, 1847, Vol. III. pp. 45—56.)

4. Allowing *wh* or *hw* to represent the initial sound of *when,* and *en* the closing vowel and consonant—'*when*' or '*hwen*' will not spell the word.

5. In Devonshire, *turnip* is *turmit.** This is not an example of a change from *n* to *m*.

6. The word *pigeon* is spelt with a silent *g*.

7. The assimilation of *ad* to *af* before *f* in AFFINITAS, is not present in *affinity*.

8. As English allows a word to be spelt like its cognate in some other language, (writing *p*SA*l*M, with its *three* elements, as if it were the Belgian PSALM, with *five*,) the paradox of an entire English line thus written, is presented in § 14, the line being—

"Heart, my heart, Oh why this sadness!"

9. The muskrat is a rat-shaped rod-ent with a strong scent of musk; yet it was not named from its musky odor.

10. Port Tobacco in Maryland is a port at which tobacco is shipped, yet *port* and *tobacco* had nothing to do with the original naming of the town.

CHAPTER II.

BASIS AND RULES OF NOTATION.

When a science is imperfectly developed, or founded on a false theory, it is sure to find itself in difficulties and restrictions, which form a stumbling-block to the student, and frequently cause its rejection altogether.—*W. G. Herdman*, Art Journal, 1849, p. 330.

The complete alphabet *must not contradict the Latin* parent alphabet; that is, every Latin letter adopted into the complete Slavonic alphabet, must have no other than its Latin power, Latin being, as it were, the universal language.—*Poklukar*, Ankündigung eines . . . Universal- oder Welt- Alphabetes. Laibach, 1851.

None but *Latin letters* are to be admitted into the universal alphabet.—*Max Müller's* Languages of the Seat of War, London, 1855, p. 54. . . . . with a due regard to the primitive power of the Roman alphabet.—*Sir W. Jones.*

Finding the statements respecting the Latin alphabet to a certain extent contradictory and unsatisfactory, I resolved to investigate it, with the intention of using it *strictly according to its Latin signification*, as far as this could be ascertained. *Haldeman*, Latin Pronunciation, Philadelphia, 1857.

§ 42. *Although the Roman alphabet* has been extensively used as a basis of notation, the Russian occupies a wide space, not only for the Slavonic languages which employ it in a modified form; but it constitutes one of the alphabets of Wallachian, and is extensively used by the Russian philologists for the various languages investigated by them—but not exclusively, for Castrén uses the Roman alphabet for Samoiédic, and Poklukar (apparently an Illyrian) recommends it for the Slavonic languages. Duponceau (Am. Phil. Trans. Vol. I., New Series, 1817, p. 264,) recommended the "small Greek alphabet" (excluding capitals) for general purposes, with additions from the Russian.

* Palmer's Devonshire Dialect, 1837, p. 91, mentioned also in George Jackson's Popular Errors in English Grammar, 1830, p. 24. This curious form has been developed spontaneously and independently by two children when learning to speak, in a locality where the existence of such a sound was unknown.

43. *The Latin alphabet is adopted* in these pages, after considerable practice with other modes of writing, and letters are recommended which have not been used in collecting examples from native sources; so that *nothing is recommended because it was familiar, or in use in the vernacular of the writer.* The object in view has been to subserve the cause of science, from a scientific basis.

44. *The Latin alphabet is very ancient,* its power can be ascertained better than French, when this is investigated from books alone, and it runs parallel with Sanscrit, Greek, and the archaic portions of English. As long as Latin was studied for its literature, its pronunciation was of secondary importance. Now that it is to be quoted, not only to solve the deepest problems, but to give to school-boys an idea of the steps in the formation of a vernacular word,—it has become necessary to lay aside the conventional pronunciation, at least when lessons in the genuine principles of etymology are given.

45. *Ten years hence,* every pupil in a grammar school may know that he cannot derive an English word with a *cay* power, from a Latin one with a letter called *see,* (as *canker* from cāncĕr, or *sickle* from sīcīlĭs;) nor pervert Latin cēră (wax) in *one* direction to enable him to derive *cerate;* or vāllū^{m} in *another,* to *remove it* from *wall,* the initial of vāllū^{m}, Sanscrit vălă, and *wall,* and of cēră and Irish *ceir* (*wax,* with *k*) being identic.*

46. *Yet the bigotry of a false education* is such, that for a few years it will be as difficult to convince school teachers, that an *identic syllable* is used in the English (*e*)*lide,* the German *leid* (an injury,) and the Latin LÆD(-o, I injure,) as it is to convince them that letters called *jee, e, double-you, dzhee, a, double-you,* cannot (literally *call out, name,* or) *spell* "gew-gaw."

Rule 1.

47. *Every simple sound or element should have a single letter to represent it.*—Max Müller, Latham, Lepsius, Rush, Matushik.†

47 *a.* "This excludes the combinations *ng, ch, th.*"—*Lepsius.* It excludes Lepsius' 'p, &c., for *p* and *h* in ha*p*hazard, because he has already a *p* and an *h;* and g′ in *gem,* because he has *d* and French *j;* and it excludes German *z,* Latin *x,* Albanian *ndzh, mb, nd,* &c.

* It appears from Prof. T. F. Richardson's "Roman Orthoepy," New York, 1859, that he has taught this subject in Rochester University for the last eight years, with the concurrence of the authorities. This institution has therefore the honor of taking the lead in *Latin* instruction, by rejecting the barbarous jargon which has hitherto usurped its name and place. Here we find J as in *year,* Æ is *eye,* and C, G, are *cay, gay.* The learned Kraitsir has also done much for Latin in his "Glossology," New York, 1852.

† The same combination of sounds should, under the same circumstances, be always represented by the same combinations of symbols, and conversely. . . . I consider also that contractions are admissible (a single letter for any combinations of frequency) provided they are always used in the same sense.—*Ellis,* MS.

48. *Rule* 1 *excludes that false notation* which has arisen from inability to analyze sounds. Several English orthoepists regard *oy* as compound, because they can detect its vowel or initial in other places, who suppose *i* (eye) to be simple, because they cannot get quite the same initial vowel in other places.

49. *One letter for two sounds being unphilosophic,* there can be no rule to restrict such a license, and where the Italian fancies there is a necessity for a *ts* and a *tsh* character respectively, the Albanian with equal propriety, may ask for their reversals *st* and *sht.*

50. *There is no scientific reason* for writing *kinn* in German, and $k_2$in-or c'in for *chin* in English (§ 21, &c.,) because *dzh tsh are not always due to gutturals,* as in Italian *gioglio* (LOLIU^m,) *giglio* (LILIU^m,) *giraffa, concistorio, cinghiale, ciocciare; checkmate, charivari, chaparal.* *Cay* may also become *s* or English *z,* as in despiCable, despiSe; and if g_2 or *g'* is to have the corrupt power in g_2*em* because it is often derived from *gay* (from any guttural, or from *h,*) shall we spell *jealous* with it? or with a marked *z?* because it is from *zealous,* and in fact, English *z* and *j* are more nearly allied than pure and corrupt *g.*

51. *But cay and tshee, gay and dzhee,* have no analogy, still less have they affinity. "En histoire naturelle, rien n'est plus trompeur que les analogies," says Cuvier. It is true that *cay* may become *tshee,*—any guttural may become any dental or palatal, (as χ becomes *s* in *surgeon,*) but if they were allied, *tshee* would readily become *cay,* when some would deem it necessary to indicate a *cay* thus derived, by an underived *tshee* character. Compare HÆREŚIS with Sp. here*g*ía. A prognathic African will convert *wreath* into *reef,* but not the reverse; § 301. Here there is analogy but not affinity between *f* and *th.* Stones roll from mountains into valleys, yet this is no proof that valleys are a kind of mountains. An immersed cork will rise, but not because it has an affinity with surface water.

52. *Those who wish a tshee sound* to be represented by a guttural basis, are inconsistent, having failed to provide one (as χ') for *sh* in forms like *chamois* (from *gems,*) *sherry* (Xeres;) Fr. *machine, chambre, chien, chou;* It. *scimia* (SIMIA) *vescica* (VESICA;) or Fr. *j,* in *joug, jour, jeune, manger, cage* (CAVEA,) *orge* (HORDEU^m;) and a different one to indicate the common change from *sh* (through ṡJ) to *sk* in *skiff, ship,* which is fully as important as that from *g* pure to *g* corrupt. Nor are the most important and characteristic mutations of Russian and Polish, of Welsh and Irish, or of Greek (κριΓῆ, κρί Ζω; Ger. fraG-en, φράΖω,) deemed worthy of special notation.

53. *The use of the same base letter* for *g*ame and *g*em, and for *c*ar and *ch*ariot, to accommodate Sanscrit and other languages, really contradicts the principles of Sanscrit orthography, which does not acknowledge any affinity between these gutturals and palatals, as (using Eichhoff's orthography) in AG, or AJ', (to move.) Eichhoff's roots 268, KAKH (to cry, to laugh,) 244, J'AKS (to cry, to laugh,) 267, KAC' (to resound, to laugh,) and 211,

çuc′ (to cry, lament,) are essentially the same root; and if the Hindoos are willing to spell corrupt *dzh*, *tsh*, differently from pure *gay*, *cay*, we should not insist upon spelling them on the same basis.

54. *Many find it difficult to believe* that numerous Latin and Greek words are older than Sanscrit; so the scholars of our day have formed a fictitious Sanscrit, as formerly a digammated Greek was formed, because it was the fashion to believe Greek older than Latin, ὄϊς older than ŏvĭs, and the Sanscrit root *tshad* or *tshand* (to shine) older than Latin cāndĕo. Admitting the root *cad* or *cand* in some antecedent of Sanscrit, this does not give age enough; forms like *nd* not being original. This *cand* is probably older than *cad*, where *d* has absorbed the *n*, and newer than the probable true root CAN, from the *n* of which the *d* of *cand* was educed.

RULE 2.

55. *No letter should represent more than one sound.*—Latham, Lepsius.—Hence, if *t* is proper in *tap*, and *h* in *hat*, *th* cannot be used as in *that*, *three*.

RULE 3.

56. *Sounds made by one contact of the organs of speech, are not to be represented by a letter made to represent a sound belonging to a different contact.*

56 *a*. Hence, a pointed *d*, *t*, cannot be used for *th* in *then*, *thin;* a pointed *s* for *sh*, which is often derived from a guttural, or from *sc;* a pointed *c* for the *t*, &c., in *tip*, *sip*, *tsip*, *ship*, *tship*. In all these cases this rule would be broken, for *th* is not the aspirate of *t* in the sense that Welsh *rh*, *ch*, (German *ch*,) are aspirates of *r* and *cay*. *Th* and *s* have equal claims to be considered the aspirate of *t*, *s* being as near the *t* position posteriorly, as *th* anteriorly.

57. Mr. Hale in the Philology of the U. S. Exploring Expedition, assigns Latin (J) *yea* to French *j*, a corruption which shows little respect for the purity of Latin, and which would tend to barbarise it, to the extent of its adoption.

58. *Sh is in no sense an aspirate of s*, and as it is perhaps more often derived from a guttural than from *s* or *t*, it is a great error to represent it by a marked *s*. Indeed, it would be more proper to represent *s* by an *sh* character. Several English alphabets have an *sh* character made to recall this combination, which is as absurd as to let *fhin* spell *thin*, because it is allowing an aspirate sound belonging to one contact, to be represented by marking as *aspirate*, a known *aspirate* of the adjoining contact.

RULE 4.

59. *The group of letters representing a distinct word is to be separated by spacing from preceding and succeeding groups, and the order of Latin typography is to be preserved.*

59 *a*. *This forbids forms* like *would'nt*, &c., for *would nt, had nt, I l, I v, I m, you v, we l, we r, he s, t will, it s*, or *t is*, &c. French is badly written on account of this jumbling of the signs of entirely distinct words; writing as two, the five words "qu' estc'que ça," instead of *q e s q ça*. "Ah c'nest qu'une peinture" (Vadé, 2, 111,) *â s n e q une*, &c. "L'solèil s'lève (ib. p. 186,) j' suis, j' crois, j' dis." "Dans l' tems que j' l' écoute," p. 215. "Et où c'qu'est l' profit?" (ib. 3, 193,) *e u s q e l profi?*

60. *There is no more necessity* for writing French *j* against *ai*, in *j ai* (I have,) than in writing the English abbreviation *I* thus, in *I am* or *I m*. The fact that several words may make one syllable, or have but one vowel amongst them, has nothing to do with the question. The Slavonic prepositions *o, w, z*, are written separately, like other words.

61. *Some think that* t *of* tsh, *not being* quite the common *t*, requires a *tsh* character, although this *t* (and *d* of *dzh*) might be marked by those who deem it necessary; but if *t* in *tsh* is drawn back to meet *sh*, this may take place with the final *t* of one word, and initial *sh* of the next; and with all coalescing or diphthongal pairs, giving to the syllables *courtship* the sound of *core chip;* and using the English diphthong *oy* in saying rapidly "the *law is* just," as if "the *loys* just," making three syllables instead of four.

62. *Although in Latin poetry* the concurrence of two vowels, as in (Virgil, book 1, line 177,) CEREALIAQVE ARMA, requires the first to be rejected, (making CEREALIAQV ARMA,) yet the measure may be preserved if we allow a diphthong to be formed, as in the same line, where *u* of UNDIS may be made the last element of a diphthong, the initial of which is nasal A, the words being CORRUPTA^{m} VNDIS. Compare Æ with a nasal A, in line 41, NOXA^{m} ET;—EJ, line 45, SCOPULOQVE JNFIXIT;—U^{m}J, line 46, DIVU^{m} JNCEDO;—Œ, OJ, line 48, GERO ET, or GERV ET, &c.

RULE 5.

63. *The Latin alphabet should be the basis, each letter being used in its Latin sense, and restricted to the sound it was made for.* Latin orthography, as that of an Indo-European language, exhibits words which still exist with the Latin sound. These, however few, should have the Latin spelling, unless this is inconsistent with the preceding rules.

RULE 6.

64. *When a sound unknown to Latin has arisen, it should be provided with a new or modified character.* Rules 5 and 6 constitute the philosophy of notation, that alone by which the entity, comparative physiognomy, and history of words can be portrayed.

65. *The empiric mode* usurps Latin letters for barbarian sounds, thus separating them from the elements with which they have been associated from remote antiquity.

66. *Professor Max Müller* would have none but Latin letters used. This is too stringent a rule, as new letters should be added where new sounds have been added.

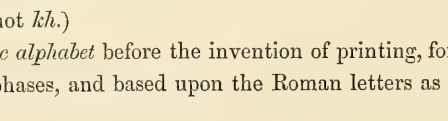
67. *Some alphabetists take credit* to themselves if their unlatin pages present a Latin appearance through the misemployment of Latin characters (but not letters.) They sprinkle them with the unlatin, unitalian, unspanish and unfrench letter *kâ*, pervert *qoo*, made for a throat sound, perhaps to represent *wh;* use the capital "A" in one sense and the small letter in another, with perhaps neither in its Latin and Romanic sense; use Teutonic W for a Latin sound and its letter, and pervert Greek ε and Υ that they may represent Latin sounds already represented. Hence,

68. *If we have no use for certain characters,* as those of *b, p, f,* in some of the American languages, we can by no means employ them for new sounds unknown to Latin, to give a deceptive Latin page, or to accommodate a frontier printing office. Nevertheless, to use the *b* character for an aspirate of *m,* and the *f* for English *wh,* would be trivial errors when compared with the perversion of *c* for English *sh.*

69. *Dr. Latham's second rule* (English Language, 1841, Chap. IX.) should be remembered in forming new characters, and especially in the application of diacritic marks. It requires "That sounds within a determined degree of likeness, be represented by signs within a determined degree of likeness; whilst sounds beyond a certain degree of likeness, be represented by distinct and different signs, *and that uniformly.*"

70. *Examples of allied letters* for allied sounds occur in the Latin CG, IJ, UV, BP, PF, FH. Greek has Δ *d,* and its liquid Λ *l;* a dot over Arabic *r* makes English *z;* in Persian arrowhead, *aleph* and *ain,* and also *r* and a variety of *z,* are distinguished by the position of a wedge on the left or right; Sanscrit from *b* forms (English) *w,* and *p-h* from *p;* but *t, t-h, d, d-h,* are quite dissimilar. In Thibetian, the affinity is exhibited between *b, p, ph; t, d* (but not *th;*) and *g, k,* (but not *kh.*)

71. *Welsh had a philosophic alphabet* before the invention of printing, for the representation of the mutes and their phases, and based upon the Roman letters as follows:—



Here *m* is acknowledged as a nasal *b,* *n* as a nasal *d,* and perhaps *ng* as a nasal *gay.* Aspiration is indicated by a line, which on the left of the *gay* character, would have given it the sound heard in Belgian, and as this is wanting, the laws of permutation which would place it in a word, cannot bring it forward. Hence *gafr* (Latin căpĕr a goat) becomes *dy afr* (thy goat) instead of *dy ghafr*—the analogous form.

CHAPTER III.

ALPHABETS, PICTORIAL, PHILOSOPHIC, AND CONVENTIONAL.

. . . . c'est que l'écriture est un ouvrage encore bien imparfait des hommes, et que la parole est une création de la nature.—*Olivier*, Des Sons de la Parole, Paris, 1844.

§ 72. *It is agreed* that the diverse Latin, Greek and Hebrew alphabets have been derived from the Phenician, and that the earliest form of this was hieroglyphic, each letter being the picture of an object whose name commenced with its power. The letter Qoo pictured the human head and neck, the neck being made as a vertical line below, until writing in two directions threw it to the right (Q, q,) or (ꝑ) left. R was a side face looking to the right, the tail representing the beard; but, as this was sometimes omitted, we find that *r* has two forms (R, P,) in different Greek inscriptions.

73. *The earlier form* (ר) of the Hebrew ג gimel represented the head and neck of a *camel* (Hebrew gāmāl) looking towards the left, the direction of Hebrew, Etruscan, and some Greek writing; whilst the Greek (*Γ*) gamma represented it looking towards the right. One of the forms (<) of this became rounded into Latin Cay, acquiring a new power as readily as the word acquired initial *cay* in the Latin CAMELUS, *sh* in the French *chameau*, and *dzh* in Arabic. Hence,

74. *There are several objections to hieroglyphs.* Every language would require a different set of symbols; the symbols for allied sounds would be dissimilar, and the power of the characters would vary with the name of the objects represented, until variations in the written forms would cause the originals to be forgotten, so that instead of more accurate pictures of an *ox*, a *house*, a *camel* or *cynocephalus*, and a *door*, we should find the apparently conventional figures *a*, *b*, *c*, *d*.

75. *Hieroglyphic or picture alphabets* would be readily suggested at the invention of writing, and they are more easily learned and remembered than any other kind. On this account, a French hieroglyphic alphabet has been proposed—*Les Hiéroglyphes Français*, par C. Chesnier, Paris, 1843, in which a pointing finger (*in*-dex,) stands for the nasal vowel *in*, an *an*-gel for *an*, the numeral 1 for *un*, a pink (œillet) for short *eu*, a sword (épée) for the vowel of *fate*, a hatchet for short *a*, the head of an ass for *â*, a pipe for *p*, and a bomb for *b*, &c., with symbols for *bl*, *pl*, *cr*, &c., requiring fifty-five characters for the French language.*

* It is applied to foreign languages in the most perverse manner, the aspirate of the Spanish word *evangelicos* being given as English *gsh* (in egg-shell,) and the nasal *an* is placed in *tanto*, and in the Greek *amphi*. In Italian, French nasal *in* is placed in *denti*, *esempio*, and nasal *on* in *contare*. In English, the same vowel is assigned

76. *Figures of the organs of speech*, either pictorial or mnemonic, must have attracted attention at an early period; and it is probable, that when the knowledge of the hieroglyphic origin of the common alphabet was lost, the form of the letters was influenced by the position of the vocal organs, as in figuring the closed lips in B, and their circularity in O. Pownal (Study of Antiquities) accounts for the vowel characters in this manner. I (in marIne) would represent the linear aperture, the figure being turned to range with other letters. A (in Arm) would represent the mouth well opened. T might figure the tongue rising against the palate; θ the tongue forming an obstruction in the middle of the mouth; ϕ a similar obstruction by the two lips, but with a vertical line to distinguish it from θ. The middle line of E (in vEin) was originally as long as the others, and might represent an opening of the mouth nearly as narrow as that of I. H was much like E, being a square with a horizontal medial line, and in some Greek inscriptions, the character H represents the consonant *h*, in others the vowel *e*.

77. *Such a system is impracticable* from the difficulty of figuring the position of the inner organs; and as the number of essentially distinct elements is not great, a pictorial representation of them would be as little worthy of attention as a proposal to use the sign III instead of the numeral 3 in arithmetical processes, as being more suggestive of *three*.

78. *An anonymous author* issued a sheet from Lockport, New York, in 1853, proposing a set of characters to indicate the organs. Here B is *b*, its reversal ɑ (with the apex of the semicircles angular) makes *p*, and ɑ (with the curve angular) is *f*, the base representing the lip and the top the teeth. This reversed, or facing to the right, is *v;* a character like m (with the left side rounded like the right) is *m*, and *w* when inverted, leaving English *wh*, German *w* and Greek φ unrepresented. D is taken as the base of the dental letters, the curve being the palate and the stem the tongue. Yet, whilst *n* is a nasal *d* (as *m* is a nasal *b*) the first and second lines of N are assumed to represent the nose, and the third line the tongue.

79. *A philosophic alphabet* would represent the same phase of speech in the same manner, and A. D. Sproat has endeavoured to accomplish this, as in ı *t*, ⌊ *d*, ⊢ *n*, ⊢ *th*. Here the base line indicates vocality, the angular one aspiration, and the medial one nasality; but the *n* is discrepant, it represents a surd *n*, it wants the base line to make it indicate the common sonant *n*. This system has a shorthand form.

80. *Pitman's Phonography* has a philosophic basis, as far as this is compatible with rapid

to *for*, *of*, *none; men* is mén (mane,) *have* is âv, *and* has nasal *in*, *hath* is âs, *the* has French *z; despised* is despă-ist, with pure *st; others* in French orthography would be ăzzœurss, and Goldsmith and Göthe ought to have spelt their names *Golshmeet* and *Göt*. In German, *euch* is made up of short French *a*, long *œu*, and French *ch* or English *sh; zu* is made (in French spelling) the impossible *tzou;* German, English, and Greek initial *h* is silenced, and Greek θ χ are turned into *k*, *t*.

writing, and it might perhaps be adapted to print.* But as it is an essential feature of shorthand, that every available sign shall be employed, that for English *th* would be assigned to some other sound in a language without this lisp, which would destroy the uniformity of notation between different languages.

81. *Script and print are essentially different* in this, that as facility in execution must be a primary object in writing, the most complicated character can be printed with the same ease as the simplest one. But, notwithstanding this feature, a uniform notation for writing and print is perhaps desirable. The two kinds of common print, roman and italic, are copied after manuscripts, and the forms of written and printed Greek do not differ.

82. *The Cosmosphonography* of Gouraud† is an attempt to construct a condensed writing character, which may be printed with separate types, specimens of which he gives. The author is said to have been a fluent lecturer in French, Spanish and English, but he has made no critical observations on pronunciation.‡

83. *Of conventional alphabets,* the Cherokee is a good example. Sequoyah the inventor had a book in the European characters, which, as he inferred or was informed, conveyed intelligence, but in a mode as obscure to him as the Egyptian hieroglyphs to father Kir-

* Henry M. Parkhurst (Ploughshare, Washington, June, 1853,) has proposed such a "Cosmophonetic Alphabet." His alphabet is inconsistent; because, for example, surd and sonant marks were deemed necessary for *p*, *b*, but not for *w*, *m*.

† Practical Cosmophonography: a system of writing and printing all the different languages, with their exact pronunciation, by means of an original Universal Phonetic Alphabet, based upon Philological Principles, and representing analogically all the Component Elements of the Human Voice, as they occur in Different Tongues and Dialects: and applicable to daily use in all the branches of business and learning, illustrated by numerous plates, explanatory of the calligraphic, steno-phonographic, and typo-phonographic adaptations of the system; with specimens of the Lord's Prayer in one hundred languages; to which is prefixed a General Introduction, elucidating the origin and progress of Language, Writing, Stenography, Phonography, etc., etc., etc., by Francis Fauvel Gouraud, D. E. S., of the Royal University of France, New York, 1850.

‡ In his opinion (p. 76,) there is an "absolute identity" between the English *an*, l-*en*-t, f-*on*-t, s-*un*-k, and the French nasal vowels *an, in, on, un*, respectively. He assigns the C^k^eltic vowel in *fat*, to French, German, Italian, &c., and he considers the English *ou* in *fount* to be the vowels in *nor* and *put*. He says of the French vowel in *peu, vœu*, that it is "a sound which the English learners of that language generally think so difficult to pronounce, although they use it a hundred times a day." He assigns the French vowel in *cœur* to English *cur*, and finds French *u* in rapt*u*rous. The numerous versions of the Lord's Prayer are given in their peculiar orthography, without pronunciation or translation, so that such series of Chinese or Cherokee characters must be useless to the great mass, even of philologists. No. 33 is a specimen of "Gothic" in Gothic characters, with some of the words improperly divided; No. 61 is "Mœso-Gothic" in Roman letters, being the same thing. The latter is credited to Ulphilas, the former, in the Ulphilas character, to Stjernhjelm, who gives a plate of it in his version of 1671. The foreign alphabets are in bad, and often inaccurate lithography. Some of the versions commence with the prayer, as the Hebrew, Irish, Armorican, and Croatian; others commence with the verse (Matthew vi. 9,) as Gaelic, Welsh, Russian, and Cherokee, so that comparisons may be thwarted at the commencement.

cher, or the characters on a tea-chest to a London grocer. He used them in a syllabic sense, varying their forms, and adding others to complete the number eighty-five. Here K became *tso*, and J *coo*, which latter is not so bad as making it *zh* or *dzh*. The second and fifteenth word of the Lord's Prayer in Cherokee, is, in French orthography—că-l'ŭn-lă-tí, (heaven,) but with German flat *k* and *t*, the last vowel as in English *pit*, accented, the *a* in *art*, and the second syllable exactly the French *l'un* (the one.) In Gouraud's Transcript, No. 30, this word stands first in the third line; and the third from the end of the first line. The characters are read towards the right.

84. *Although the Cherokee alphabet* is syllabic, beginning with a consonant, as *lo*, *tlo*, *tso*, a word may begin with a vowel, so that there are vowel characters, as D in *a*rm, R in v*e*in, T in f*ie*ld, &c., and this being the case, it may seem singular that the inventor did not fall upon a strictly alphabetic notation, seeing that, when writing W *la*, *ȣ le* (*lay*,) r *li* (*lee*,) M *lu* (*loo*,) he might have used WD, ȣD, or RD, for *la;* WR, &c., for *lay;* and WT, &c., for *lee*.

85. *But there is a great difficulty* in getting an abstract idea of a consonant, as distinct from a syllable. The con-sonant 'P' is nothing when alone, 'L' is something. But *pa* and *la* are alike in termination, with an initial difference. Their notation must be analogous, and if syllabic, it can be appreciated. But if the initial and final effect of *la* have each a character for the sounds which are so readily appreciated, *pa* must have the same *a* final, whilst it has nothing corresponding to *l* in the sense of an element which can be pronounced independently. The *p'* of *pa* cannot be detached from *a*, it is a nullity without it, *pa* must therefore have a single character, and if *pa*, so also *la*.

86. *The same course of reasoning* perhaps, causes Dr. Lepsius to assign single characters to the Hottentot clacks, which are made with a *consonant* position followed by a *vowel* position of the organs;—to term *m*, *b*, *p*, equally explosives; and in fact, *m* is whatever *b* is, with nasality added, differing as a nasal vowel differs from a pure one. If then, *b* is an explosive, so is *m*, and if *m* is not explosive (and it is not) neither are *b*, *p*.

87. *Those who term P an explosive*, take the Tsă-lă-kí view, mistaking two phenomena for one. P may be compared to a gate in a water course: if quite open, the water flows like a vowel sound, if let down nearly close, the flow may resemble that of *f* or *th;* if closed entirely, or closed or opened suddenly, the gate acts like P on the current of the voice or breath, or like B, should the water continue to gurgle and dam up behind the obstruction; or like M, should the stream flow over the gate, or find a side passage; and when the stream issues suddenly, in an "explosive" manner, it is the current, not the gate or obstruction, which is explosive.

CHAPTER IV.

THE LATIN ALPHABET.

At present, ancient Latin usages are the only feasible basis for an alphabet that the learned in all nations can use; the letters, as far as possible, having their ancient Latin values.—*Ellis*, Universal Writing and Printing, Edinburg, 1856.

The life of all language is pronuntiation.—*Roger Williams*, Key into the Languages of America, London, 1643.

La prononciation est la chose la plus importante dans l'étude d'une langue . . . . La prononciation est à une langue ce que les couleurs sont aux figures d'un tableau.—*Robello*, Grammaire Italienne.

. . . . . it will be found upon critical and candid inquiry, that much, which at first sight strikes us as barbarous, is only ancient.—*Pennington*, An Essay on the Pronunciation of the Greek Language, London, 1844.

§ 88. *Most of the languages of Europe* for which the Roman character is used, preserve the original power, except that the greater number of sounds in some of the modern languages prevents each of the characters from being restricted to a single power.

89. *The characters* of the Latin Alphabet are the *twenty* following:—A, B, C, D, E, F, G, H, I, L, M, N, O, P, Q, R, S, T, V, X; and of these, *nine* had the same power as in English, namely: B, D, F, H, N, P, Q, T, X.

90. *The names of the letters*, according to the ancient grammarians (Schneider's Grammatik, Berlin, 1819, p. 2,) are, for the vowels, their power, and for the consonants, the following syllables, given in English spelling,—*bay, cay, day, aif, gay, hah, ail, aim, ain, pay, coo, air, ace, tay;* to which Schneider adds *kah*, and I *consonant*, V *consonant*, these being called by Eichhoff (in English spelling) *yee*, and *way*. Sometimes Greek K was used in writing CALENDAE; and Y, Z, appeared in unnaturalised Greek words, with their Greek power of French *u*, and English *zd*.

91. *In modern books* when I would have its consonant power of English *y*, it is sometimes varied to J; and V *oo* is sometimes rounded for a vowel, and left angular for its consonant power of English *w*.*

92. *The Latin Vowels* are long (marked ¯,) and short (marked ˘,) the short ones having *the same quality* as the long ones, with but half their length. Some words are long or short according to the usage of the poets.

93. *The power and name* of the Latin vowels are always as in the following English words—

* For example—"DE SONIS LITERARVM GRAECARVM TVM GENVINIS TVM ADOPTIVIS LIBRI DVO AVCTORE GVSTAVO SEYFFARTHO,"—etc. Lipsiae, 1824. This author uses the spellings—vt, huius, quamuis, inuita, leue, diuersa, subiecta, vera, prouocari, obiicere, &c.

A*	*long* in	ārm,	short in	ărt,	never as in	*at*
E	"	vēin,	"	ĕight	"	*ebb*
I	"	fīeld,	"	deceĭt,	"	*it*
O	"	ōh,	"	ŏbey	"	*ox*
V	"	fōōl,	"	fŭll,	"	*up*

94. *Their power is the same in the diphthongs*, except that the second element is slightly varied to make them pronounceable in a single syllable; for, as Prisc^{k}ian, the chief of the ancient grammarians, says—"A diphthong is a union of two vowels, both of which are sounded."† Thus Æ is *eye*, the Greek AI, sometimes seen in Latin and occurring with it in an inscription (No. XI.) in the Capitol at Rome, where the consecutive words occur—VERNAE KARISSIMAI SVAE. Œ is very like o-i in go*ing*, show*y*, and the Portuguese ŒTO (or oito) eight; EI or EJ nearly as in pre*ying*, Bohemian *ey*, or Spanish *ley* (law,) AV or AU are like *ou* in out, or Danish AV in HAVN (rhyming with *town*) a *haven*. If, therefore, *hound* were a Latin or Danish word, it would have the (only correct) orthography—"havnd." AU has its Latin sound in most of the modern languages; Æ and Œ (or oi) in Portuguese, as in "Shanghæ" (-high,) the orthography of which is due to the Portuguese navigators.

95. *The terminations am, em*, &c., are nasal vowels, as in French and Portuguese, no final *m* being heard even, when the next word begins with a vowel, where it would be heard in French. The quality of the nasal vowel is that of its pure form (as far as we

* A in *arm*, because *according to the ancient grammarians*, it must be made with the mouth gaping or expanding, HIATU ORIS as described by Marcianus Capella, and RICTU PATULO in the verse of Terentianus (Maurus) and the prose of Victorianus (Afer;) or like the Greek *A*, which, according to Dionysius of Halicarnassus, was made with the mouth open as much as possible.

"The E which follows, is formed by reducing a little the aperture of the mouth, and drawing the lips inwards," that is, in comparison with Ah, which he had just described.—*Victorianus.*

I—"The mouth half closed, and the tongue lightly touching the teeth, gives the sound."—*Victorianus.*

O short "is pronounced with a not great opening of the lips, and with the tongue held back; but the long one pronounced, will give a tragic sound from the produced lips (PRODUCTIS LABIIS) and rounded mouth (RICTU TERETI, slender cavity of the entire mouth?) the tongue detached from the palate."—*Victorianus.*

V—"Whenever we pronounce this letter, we will emit it with lengthened and converging lips."—*Victorianus.*

V—"Whenever we prepare to emit this sound, we will endeavor to utter O, and thus the sound will be produced, but with lengthened and converging lips."—*Terentianus.*

"V is formed by constricting the mouth and projecting the lips a little."—*Marcianus Capella.*

† DIPHTHONGI AVTEM DICUNTUR QVOD BINOS PHTHONGOS, HOC EST VOCES COMPREHENDUNT, NAM SINGULAE VOCALES SUAS VOCES HABENT. See Haldeman's Latin Pronunciation, Philadelphia, 1851, p. 28 and 69. When barbarians prepare their so-called "Latin Grammars," without consulting Prisc^{k}ian, we need not wonder that so many of them do not know the difference between a diphthong and a vowel, or consonant and vowel combinations like UA in QVARE. This is not a criticism upon their conventional pronunciation, but upon their definitions, which assign to "Æ" a *single* sound and call it (di-phthong) *two* sounds, and to "I" two sounds, but calling it a (vowel) single sound.

know,) so that *im* is not to be read in the French manner, with the vowel of *fat* nasalised (as in vin *wine*) but with that of *field*, said to occur in the Portuguese *im*.

96. Cay *is always K in Latin* (according to Latin authority,) as in Anglish, old high German (which also uses *k*,) Welsh, Irish, and Gaelic.* Hence, to confound the proper names CYRUS and SYRUS (except perhaps as English words,) or the Anglish *cing* (a king) with *sing*, is like saying *sea* for *key* and *septic* for *sceptic*. Gay is always as in *give*, *get*, never as in *gipsy*, *gem*, or as in French.

97. H *is never silent*, even in the interjection OH, corresponding to the German *ach*, Irish *och*, &c. In representing certain Greek sounds, H is used after C, P, R, T, to indicate their aspiration—a mode of writing which (except for Th,) was originally Greek. In some Latin inscriptions, the single elements χ and ϕ are represented by H deprived of its first vertical line, and united into a single character with C and P.

98. J, *as in German, Belgian, Polish*, &c., or English *y* in *yet*, *year*, never as in *jet*, *jeer*, or as in French.

99. L, *according to Victorinus*, is made with the tongue and palate at the base of the upper teeth, which answers sufficiently to our *l*. But Priscian assigns three powers to the Latin letter, one of which may have been the Polish variety.

100. M *as in* man, *but when final*, as in the Portuguese *bom*, French *bon* (good) even when the next word begins with a vowel. N never indicates nasality, although Chavée (Lexiologie Indo-Européenne, Paris, 1849, p. 22,) asserts that it does in Greek, but apparently without any ancient authority.

101. N *has two powers*, the first in *no*, the second in *angle*. The latter occurs in all cases before C, G, X, Q, where it was called N ADULTERINUM or impure. Nigidius Figulus, cites for it words like INCURRIT and INGENUUS, where English practice would place pure *n*.

102. Q *is a duplicate* of Cay, and indicates that the V *oo* which follows it has the consonant power in *w*ell, and not the vowel power in *oo*ze.

103. R *requires to be trilled*.

104. S *has its Spanish power*, as in *hiss*, not that in *rose*, *miser*, *sure*. Its power in *miser* occurs in Italian, German, and French, but not in Spanish.

105. T *as in tun*, never as *s* in the French na-ti-on, nor *sh* in the English na-tion, nor *ts* in the German na-ti-on.

106. V *when a consonant, always* as English *w*. (See § 93 note on V.) This is the opinion of Bentley, Pennington, Key (Penny Cyc.,) John Jackson (Chronological An-

* Among the inscriptions of the Vatican, we observed the name *Eutychia* in one place as EVTYCIA in Latin letters; and the Latin words IN PACE borrowed in a Greek inscription under the form *ENΠAXH*, as one word.

tiquities, London, 1752,) Payne Knight, Rapp, Eichhoff, Webster, Chavée, Donaldson, the author of "Living Latin," London, 1847, and Prof. John F. Richardson, (Roman Orthoepy, New York, 1859.) The Rev. Henry Thomson (Encyc. Metropolitana) says, "There is no evidence whatever that the Digamma or the Latin V was thus pronounced," that is, as English *w*. On the contrary, there is no evidence that English *v* was known to the Roman grammarians; it is a vocal *f*, yet *f* is the only element described as being made by the contact of the *lower lip and upper teeth.* (See the descriptions of Terentianus, Victorinus, and Capella.)

107. X as *cs* (sometimes as *gs*, not *gz*,) even when initial.

108. *In Latin and Italian* there are double consonants, both of which must be pronounced. Thus the *ll* in āllēgŏrĭa are to be sounded like *ll-l* in all-loving; *nn* in pēnna (a feather) as in the Italian Gio-van-ni (John.) *This is entirely different* from the improper use of doubled characters in German, French and English, to indicate etymology, the shortness of a preceding vowel, or the quality of a sound.

HEBREW IN LATIN LETTERS.

109. *The powers of the Hebrew letters* agree very well with those of Latin as given here, so that in general, a proper name will have the same sound if read in Hebrew or Latin, that is, when the same sounds exist in both languages. Latin could not represent Hebrew *shin*, (English *sh*,) and took *s* instead, and English commonly follows Latin, but sometimes takes *sh* directly from the Hebrew. Neither Latin, Greek, nor English takes the Hebrew, archaic Greek, and perhaps archaic Latin Q, which represents a glottal *k* in Hebrew and its cognates. The use of this would have made the etymologic part of the transliteration more consistent.

110. *The following have* Q in the original—Qɛmŭēl, ămālēq′, Isaaq, Jaqob (with English *y*,) Joqshan, Qa-in (Cain, a dissyllable,) Qādēsh, Qirjath, (English *y*.)

111. *As examples of the vowels,* we have forms like Sēīr, S^{h}āūl, Sodōm, Edōm, Nōd, Ammōn, Enōch, Enōs, Nimrōd, Simeōn, Lōt, Magōg, Rehōbōth, Ashterōth, Lūdūm, Lūz, Shūr, Būz, Jūdith (Eng. *y*,) Rɛūbēn, Bēthēl (not bɛ-thɛl,) Bɛthūēl, Rachēl, Josēph (Eng. *y*,) Bɛērī, Bɛērsheba, Adbɛēl, Magdīēl, Tarshīsh, Dān, Gād.

112. V *stands for English w* in Lēvī, Javan (Eng. *y*,) Arvadīte, Nīnevēh.

113. H *as a final consonant* occurs in Noah (whence the adjective Noachian,) Nineveh, Gomōrrāh, Sarah, Rebeqah, Milcah, Machpēlāh; but not in Abidāh, which ends with ā. A different aspirate (the eighth Hebrew letter,) occurs in Hebrōn, Hēth, Zohar, Gaham, Nahōr.

CHAPTER V.

THE GREEK ALPHABET.

It is clear therefore, that a uniform system of Greek pronunciation is needed; and the truth of this position very few scholars will question. Such a system independently of its giving individuality to a language—a circumstance by no means to be overlooked,—will put the Greek on the same footing with the Hebrew, which no one has yet seriously attempted to read after the analogy of any of the modern languages of Europe.—E. A. Sophocles, History of the Greek Alphabet. Cambridge and Boston, U. S. A. First Edition, 1848, p. v., 2d ed. 1854.

§114. Figure,	Name,	Power,	As in	Figure,	name,	power,	as in
Α α	*ἄλφα*	a	*ā*rm *ā*rt.	*Ν ν*	*νῦ*	n	*n*oon.
Β ϐ β	*βῆτα*	b	*b*ay.	*Ξ ξ*	*ξῖ*	cs	a*x*is.
Γ γ ˊ	*γάμμα*	g, ng	*g*iv*ing*.	*Ο ο*	*ὄ μικρόν*	ŏ	*ŏ*bey.
Δ δ	*δέλτα*	d	*d*ell.	*Π π ϖ*	*πι*	p	*p*ea.
Ε ε	*ἔ ψῖλόν*	ĕ	*e*psom.	*Ρ ρ[ῥ]*	*ῥῶ*	r	[rh as in Welsh.]
Ζ ζ	*ζῆτα*	zd	wis*d*om.	*Σ σ ς*	*σίγμα*	s	*s*eek.
Η η	*ἦτα*	ē	*th*ere.	*Τ τ ϯ*	*ταῦ*	t	*t*ower.
Θ θ ϑ	*θῆτα*	th	*th*in.	*Υ γ υ*	*ὖ ψιλόν*	y	[Danish *y*.]
Ι ι	*ιῶτα*	i	*f*ie*l*d.	*Φ ϕ φ*	*φι*	ph	
Κ κ	*κάππα*	c	*c*ap.	*Χ χ*	*χῖ*	ch	[German.]
Λ λ	*λάμβδα*	l	*l*amb.	*Ψ ψ ϕ*	*ψι*	ps, bs,	eclipse, robson.
Μ μ	*μῦ*	m	*m*oon.	*Ω ω*	*ὦ μέγα*	ō	ōwn.

114*a*. *Ου, ου, υ,* properly a diphthong like *o-w* in n*o-w*onder, which should be preserved. At an early period it was pronounced both by Greeks and Romans, like French *ou*, Latin U, the *oo* in *fool*.

115. ʻ spiritus asper (rough breathing,) English *h*, placed over the second character of diphthongs or digraphs, as *οὗ where*, read *hō-w* or *hoo*. *The* (') spīrĭtŭs lēnĭs (smooth breathing) indicates the absence of the rough breathing, as in the English *owe*. It is not indicated in inscriptions.

115*a*. *As it is hardly possible* to commence a word with a vowel, without allowing a little inaudible breath to pass before the vocal ligaments begin to vibrate, this, as Chavêe suggests, may be the smooth breathing.

116. *As* zd *has the single character* z,* so its cognate *st* is sometimes written with a single letter, as in *ἄζρον* or *ἄστρον* (a star.) In writing the Doric and Eolic dialects, *ζ* was replaced by *σδ*, as if the double sound varied from that in wis*d*om to that in mis*d*eed. The character *σ* is used, except as a final, to which *ς* is restricted, as in *σοφός*, (wise.)

* See Haldeman. Investigation of the power of the Greek *Z* by means of Phonetic laws.—*Phonetic Journal*, Sept. 24, 1853.

117. *The characters* E, H, P, X, have not the same power in Greek and Latin, which causes great inconvenience, and tends to prohibit the use of the proper Greek characters, for manuscript forms, most of which arose in the 7–10th centuries.* This difficulty should be removed by using ε or ϵ, for which authority may be found in Greg. Placent. p. 106, plate; and in the ELEMENTA EPIGRAPHICES GRAECAE of Franz, Berlin, 1840, p. 245 below. P should have the upper projection cut away, the angle rounded (*P*,) and the curve thick above, and tapering downwards. H might have the Coptic form (H) and (X) would be nearly the Coptic χ.

118. *Γ, γ, ʃ,* before γ, κ, ξ, χ, has the proper of *ng* in *sing* or *n* in *ancle, angle,* as in ἄγκυλος (curved,) Latin angŭlŭs (an angle.) Words like *sing* cannot be represented in Greek and Latin, because the *ng* sound is not made except in connection with a following guttural. In these pages *ʃ* will be used for the nasal sound.

119. Φ is written with *ph* in the Roman alphabet. It differs from F in not being made by the lower lip and the upper teeth, but by the contact of both lips, as in blowing.

120. V *was originally a Greek letter* with the power of *oo*ze, and from this the later Y, *ϒ* (French *u*) seems to have been formed, either to indicate the pursing of the lips by the contraction of the base, or to show its relation to I. *ϒ* had not the pinched sound of French *u* in the Eolic dialect, nor as the second element of the labial diphthongs; hence αυ agrees with English *ow* and German *au*, in *brown*, *braun*.

121. *Diphthongs*, αι as in *ai*sle; or like *o-y* in go-*y*e; ωι the same lengthened; ει like *e-y* in get-*y*e; ηι the same lengthened; and in all cases, the first element has its proper power.

ACCENT.

122. *The accent of Greek* differs from that of Latin in falling upon the last syllable, as well as upon the second and third from the end. There are three varieties, the acute (′) and grave (‵) used with long and short syllables, but the grave restricted to finals; and the circumflex, (^ ~) which is a union of the others, used with long final or penultimate syllables.

123. *The acute accent* indicates the chief stress, the grave a secondary one. A word bearing an acute accent on a final syllable, may have it changed to a grave in the middle of a sentence (as being weaker among other syllables,) although the acute would be preserved at the close, as in the English sentence (writing *detain* in Greek characters) "*I*

*See EPITOME GRAECAE PALAEOGRAPHIAE ET DE RECTA GRAECI SERMONIS PRONUNCIATIONE DISSERTATIO AVCTORE R. P. D. GREGORIO PLACENTINIO, ROMAE, MD. CC. XXXV. This work is abundantly illustrated with figures.

† Haldeman, Proc. Amer. Acad., 1849, p. 171; Castanis, The Greek Exile, Philad., 1854, p. 246; E. A. Sophocles, Greek Alphabet, 1854, p. 113—14.

will not δετὴν *ény longer*, I will not δετήν. So the second syllable of *renéwed* is acute compared with the first, but if we say "buds are *renèwed* évery spring," it becomes grave in comparison with the acute accent of *every*.

124. *In strict accuracy*, the acute accent seems to have been rather at the end of the vowel or syllable, the grave at the *beginning*, and the circumflex in the middle, corresponding respectively to the *crescendo* <, the *diminuendo* >, and the *swell* <> in music. The following are offered as English approximations:—sèa-dog, séed-ing, strài-ning, caraván, caravànsery, câreful, èlecampáne, ùndêviáting, ùncònstitûtionálity, ìncontêstibílity.

125. *As English has sounds* unknown to the Greeks and Romans, it would be difficult to find a line of English which they could represent or read correctly if written in their alphabets. For example—

"The proper study of mankind is man,"

.... ι πρ..πρ στ..δ.. .. μ..νκαινδ .. μ..ν—

DHI PR..PR ST..D.. .. M..NCÆND .. M..N—

cannot be written, because the power of *th* in *the*, the vowels of st*u*d*y*, the vowel and *v* in *of*, the vowel and *z* sound of *is*, have no proper characters, and the existing ones do not allow of the English latitude of power. Similarly, the line—Those things *h*anging *w*ithi*n*—contains but four letters (O, H, V, and final N) which would be written and read by a Roman in this connection. In the following examples, the Greek, Latin and English elements are nearly identic.

arm	hold	pure	bind	hero	cone	scheme	town	sweet	useful	wine	fed
ἀρμ	ὁλδ	πιυρ	βαινδ	ἥρω	κων	σκιμ	ταυν	συιτ	ιούσ..υλ	υαιν	..εδ
ARM	HOLD	PJUR	BÆND	HIRO	CON	SCIM	TAVN	SVIT	JUSFUL	VÆN	F..D

Here, the Greek ι, υ, being properly vowels, πιυρ and συιτ admit of being read as dissyllables, so that they are not true representatives of *pure, sweet*, nor would the Latin forms have been, before the modern separation of I,J, and V,U.

THE DIGAMMA.

126. *The inconvenience of one letter* for the sounds of *oo*ze and *w*ell, although not felt by some who have proposed English alphabets, was appreciated to some extent by the ancients. The sixth Hebrew letter *wow* (in *wound* from *wind*) was represented in archaic Greek by the 'digamma' Ϝ (the original of the Roman F,) and it is possible that in some dialects this had the power of German W and Ellenic (Romaic) *β*, the sonant of *φ* §119, that is, a consonant akin to English *v*, but made with the lips alone.

127. *W is the proper character* for this aspirate B, it was made for it, and is still in extensive use as its representative. "W is of German origin, and occurs first in the name of Witiges, anno 536, on coins."—Kraitsir's Glossology, p. 98.

128. *The elements of woo are sequents* in English and Latin, as in *wool*, VVLTVRNVS, but not in Greek, where they would be likely to be submitted to a naturalising process akin to that which produced the three forms—English *wolf* (=Ang. Vulf,) German *wolf*, and Swedish *ulf*. This process would be used with caution in proper names, which some would naturalise and others present in their true pronunciation. Except in the case termination, *Λύκιος* is a genuine transliteration of LVCIVS; *Τύλλιος* and *Βῆρος* are naturalised forms of TVLLIVS and VERVS, the former with French *u*, the latter with *b*, an interchange (English *b*, *w*,) which is common in Sanscrit. But Greek *β*, *ϋ*, *υ*, are no more identic than English *b*, *w*, and German *w*, in the proper name Weltzhoover, which is pronounced in these three modes (and sometimes written and printed with *b*,) in Maryland and Pennsylvania.

129. *We can now account for* the want of uniformity in the Greek orthography of Latin names, such as—

VALERIVS		Οὐαλέριος		Βαλέριος
SEVERVS	Σεούηρος	Σεϋῆρος	Σευῆρος	Σεβῆρος
FLAVIVS		Φλαούϊος	Φλαύιος	Φλάβιος
NERVA		Νερούας		Νέρβας
VARRO		Οὐάῤῥων		Βαῤῥων
AVRELIVS	Αὐρήλιος		ARISTOBVLVS	Αριστοϐουλος
OCTAVIVS	Οκταούϊος		TIBVR	Τιβϋρα
IVLIVS	Ιούλιος		LIVIVS	Λιϐιος
VVLTVRNVS	Οὐουλτοῦρνος		VERRES	Βέῤῥης

130. *Appreciating the inaccuracy* of seeming to string four or five vowels in a line (V being *oo*,) the Romans sometimes used the digamma inverted (to keep it distinct from their F,) writing OCTAꟻIAE, SERꟻVS (the modern SERVVS,) and the like, to be seen in inscriptions. Dialectically, this ꟻ may have had the power of German *w* (Spanish *b* between vowels,) as we find BERVM for VERVM.

131. *There was probably a Spanish dialect* of Latin paralleled by an Ellenic dialect of Greek, an Arabic dialect of Hebrew, and a Sanscrit dialect of some unknown original. For, in some cases, a language pure in the morning, may have sloughed off a dialectic ulcer in the afternoon of the same day, and the organs which could open sufficiently for *brig* and *kin* in summer, might close to the aperture required for *bridge* and *chin*, when opposed to the blasts of winter.

132. *The greatest corruptions occur* when the language instinct has become enervated. Then *sixt* is perverted to "sixth," although forbidden by a law of the language. Then some one may say "of like" for *alike*, as "almost" is said for *amost* (perhaps an old dative akin to the German *am meisten*,) and "out of doors" for *out adoors*—mistaking for a plural sign the adverbial -s of *towards*, *whence*, *since*, *twice*, *else*, VIX, BIS, *δις*, *ἄψ* (backwards,) the *υ* of *αὖ* (back) becoming *π* or *φ*, as in Ellenic. Compare *λᾶυρος* and *λάϐρος* (violent.)

CHAPTER VI.

THE ANGLISH ALPHABET.

With all the prejudices of an antiquarian taste, and an eye long familiar with the form in which the words had been accustomed to be read, in what has been called the Anglo-Saxon character, and with the difficulty of recognising the same words when presented in a different dress, it required a strong reason to justify the rejection of the old letters. Nothing but a thorough conviction that the Roman character would be the most legible, and would best show the identity of the present English with Anglo-Saxon, as well as the clear analogy existing in the words of all the other Germanic languages, would have led to the adoption of this type. *Bosworth*, Dictionary of the Anglo-Saxon language, London, 1838, p. clxxi.

§ 133. *Anglish orthography is nearly like* that of Latin and German. The characters differ somewhat from the Roman, which are frequently used instead. The letters are a, b, c, ꝺ, e, ꝼ, ȝ, h, ı, l, m, n, o, p, ꝑ, ꝛ, ꞇ, þ, ȝ, u, ꝩ, ẏ.

134. A as in ārm, ărt, and probably as in fāll, whăt. Compare smál *small;* stál a *stall;* fram *from;* nat *not.*

135. Cay always pure, as in Latin. Compare corn *corn;* cirnel *kirnel;* cepan *keep;* brocen *broken;* ceac *keg, cag;* ece *ache;* cennan *ken;* cynn (Irish cine) *kin;* cyning (old German cuninc) *king;* citte *kit;* cealf *calf;* cinne, cinn (old German cinni and kinne) *chin;* cild (old German cind, kind,) *child.*

136. ϵ, e, in thēy, mĕt; æ as in făt. Compare fætt *fat;* ȝæt *that;* æpl *apple;* hæbbe *have;* bænd *band;* ꝩæȝn *wagon.* Care should be taken never to use æ for this letter, but (if the proper type is not at hand) to file off the right hand side of the Roman letter. This would form the basis of a good letter for the vowel in *fat;* whilst the use of the unaltered Roman letter would tend to corrupt Latin.

137. F, (u at a later period probably as in *of, vine* (its Welsh power.) Compare ofer, ouer, *over;* efen *even;* lufe, luue, loue, *love;* hafe, haue, *have;* fefer *fever;* fif *five;* fers *a verse;* ff as in *off,* its Welsh power. In Belgian, *v* often replaces English *f,* which is a Devonshire peculiarity. Compare

Belgian,	*Anglish,*	*English,*	*German.*
voet	fot	foot	fuss
vloer	flor	floor	flur
vrij	freo	free	frei
geven	gifan	give	geben.

138. Gay pure, as in *get, give.* In gear *year;* gearn *yarn;* geolca *yolk;* geolo *yellow;* ciorl *churl;* cealf *calf;* the element after the initial is probably English *y,* which remained in the English *yolk* after the *g* was lost. Some regard *ge* as equivalent to English *y,* but as 'guard' is, (or was) provincially *gyard,* and 'cow' is *cyow;* Anglish geard (a *yard, gard*-en) was probably *gyard,* or in Latin letters—GJARD.

139. O perhaps as in *not.* Compare the double English forms mon and man, lond and land, sond and sand.

140. S, ꞅ, doubtful; perhaps pure in some dialects, in others as in *z*eal, mi*s*ery, a Somerset (zomerzet) and Devonshire form.

141. Þ as in *th*in. The Greek *θ*, *θ*, may be subtituted, or ꞇ.

142. Ð, ð, as in *th*en. When this type is wanting, ɑ may be substituted. The sonant and surd *th* were interchangeable to such an extent in the various dialects, that the letters of both fell into English *th*, with which Anglish words are often written without taking the difference into account.*

143. ꝑ English *w*, and represented by both *w* and *v*, but as the letter is a manuscript and italic form of Latin V, with the second line turned into the stem† and as it has no connection with Germanic W, *v* is its proper representative.

The following may be compared, in which the Gothic initial probably agrees with the others.

Latin,	*Gothic,*	*Anglish,*	*English.*
VENTUS	vinds	ꝑind	wind =vɪnd
VELLUS	vulla	ꝑul	wool =vʊl
VIDUA	viduvo	ꝑidꝑa	widow=vɪdo
VOLO	viljan	ꝑyllan	will =vɪl
VERMIS	vaurms	ꝑorm	worm =vʊrm

144. *Dr. Bosworth virtually admits* the necessity of measuring languages by the same alphabet—sounds by the same letters; but his use of W (where Diefenbach, Kaltschmidt, and others use V,) removes Anglish from Latin and gives it a forced and unreal resemblance to German. On the other hand, some will have 'cinn' read like *chin*, to bring it down to the English level, by removing it from its cognates, the Belg. kin, Gothic kinnus, Greek γένος, &c. The Latin V is used in the next examples—

Latin,	*Anglish,*	*English.*
VAD-ERE	vad-an	wad-e =ved
VOLV-ERE	vealov-ian	wallow =vŏlo
VAST-ARE	vest-an	wast-e =vest.

145. Y, ẏ, has its proper power of French *u*, German ü. The dot indicates nothing. It is not placed over the small *i*. 146. cs is preferred to *x*, and cꝑ to *qu*.

147. In the change from Anglish to English, the derived language often retained old forms which were allowed to become corrupt in the original. The English *wagon* is older than the Anglish ꝑaen, (as if *wine?*) whence *wain;* and the modern *rain* is precisely the Anglish 'ren,' a corruption of 'regn.'

*The English use of *th* for two sounds recalls the Greek double letters, which had different powers in different dialects; ξ being κς or χς; ψ, πς, βς, φς; and ζ, *zd*, *sd*. Without a similar reason, the Greeks would hardly have used such an unphilosophic mode of writing.

†See Emman. Thesauri, Inscriptiones; Coloniæ Brandenb. 1671, p. 414, and many old books.

CHAPTER VII.

ORGANS OF THE VOICE.

Ce qui doit encore résulter de ces considérations . . . . . c'est l'admiration qu'inspire ce mécanisme merveilleux du plus parfait de tous les instrumens, l'organe de la voix. Ah! sans doute, il a pour auteur le plus parfait de tous les artistes. —*Abbé Sicard.*

§ 148. *The larynx is the organ of voice.* It is composed of five yielding cartilages united by ligaments, and various muscles, forming a mass at the head of the trachea or windpipe, of which it is a continuation. Although large enough externally to render the front of the neck more or less prominent, the larynx is reduced within to a narrow opening, extending front and back, named the glottal fissure (rīma glōttĭdis.)

149. *Each side of the glottal fissure* has an elastic band with the inner edge (next the fissure) free, and the outer edge, as well as the ends attached to the cartilaginous framework. These bands are the vocal ligaments; they have no independent power of vibration, but are as passive as the reed of a clarinet, until acted upon by a current of air. Their tension and length vary in speech and song, but they are never quite relaxed.

150. *When the larynx is in repose,* as in ordinary breathing, the glottal fissure is widest at its posterior end. In this condition there is no vibration, even with increase of breath; to cause vibration, and consequently voice, the glottis must be narrowed to a uniform slit, (Willis.) *The singing voice* is due to a greater approximation of the vocal ligaments than is required in speech. (Faber, inventor of the speaking and singing machine, in a verbal communication.) In *falsetto* singing, the extreme edges alone vibrate. (Johann Müller.)

151. *The parallelism of the vocal cords* is the effect of volition, and is chiefly due to the action of two triangular cartilages (the arytenoid,) the anterior angles of which approach each other, and the cords with them. As every sonant element of speech requires the parallelism of the vocal cords, and every surd avoids it, there is a continual quiver of closing and opening, which can be viewed in the throat of some birds; and as eight syllables (like *pity, Popocatapetl,*) can be pronounced in a second, there are sixteen motions in this short space of time, not like the unappreciated trills of the tongue, but controlled and individualised by the speaker. This is about double the rapidity of the motion of the eyelids.

ORGANS OF SPEECH.

152. *The mouth and nose* act on the voice or breath proceeding from the glottis, by means of the lips, teeth, tongue, palate (roof of the mouth,) and its continuation, the soft

palate, or palatal veil, which bears the uvula, and acts as a valve to close and open the nasal passage posteriorly.

153. *The pharynx is the cavity of the throat* behind the uvula. It extends up to the posterior nasal passages, and is concerned in modifying the vowels.

CHAPTER VIII.

THE ELEMENTS.

At the present day, in physics and chemistry, we have no longer theorists in the sense of the schools of the last century. . . . . Such men are indeed still to be found, but only in those departments of science which have not yet acquired a truly scientific foundation; and in which, partly for convenience, partly from a deficiency of logic, such speculations are tolerated.—*Liebig*, Principles of Agricultural Chemistry, 1855.

§ 154. *This chapter being introductory* to the succeeding one on the Phases of Words, its subject is not treated fully, but will be resumed farther on. In the mean time, the words "diphthong" and "coalescent" will be used, although the English syllables *oy*, *I*, *ou*, as a vowel followed by a consonant, have no more right to a special name than the syllable *odd*. *Capital letters* will be used with their Latin (or Greek) power—others as in English, unless there is a statement to the contrary.

155. *The old division of the elements* into two classes (vowels and consonants) is philosophic and proper. Those systems are unphilosophic which make three classes for vowels, sonant consonants, and surd consonants; or which separate a class or order of sibilants; or include *l*, *m*, in an order of liquids.

156. *Vowels* (vōcālĭs *vocal, sonorous,*) *are made* of the uninterrupted voice, the distinctions between them being due to slight modifications, chiefly of the cavity of the mouth and pharynx. Vowels are *pure* (or normal;) *nasal*, as some of the French, Portuguese, and Polish vowels are; *whispered*, of which some of the aboriginal American languages afforded examples; *independent* (of expiration, inspiration, or voice,) being a vowel effect succeeding a clack; and *glottal*, in which the vowel is accompanied by a scraping effect along the rather close glottis. Its type is the Hebrew and Arabic *ain*.

157. *Consonants are the result* of interrupting the vocalised or unvocalised breath. Their quality depends upon the point where the interruption is made, and upon the nature and extent of the interruption. They are classified according to the points of contact where they are modified or interrupted.

158. *The consonants of web, whip,* and the vowels in *o*re, *oo*ze, belong to the labial contact; those of *f*ive to the labio-dental; *th*in *th*en to the lingui-dental; *deb*t, *lea*n, to the

dental or basi-dental; *s*eize to what may be called the *sigmal* contact (from the Greek letter, and from σιγμὸς a hissing,) for *s* has more affinity with *t* than with *sh*, which, with *zh*, belong to the palatal contact. The guttural contact is formed by the back part of the tongue and palate, as in *y*oun*g*, ca*g*. The vowels in p*i*que, v*e*in, are guttural vowels. The glottal contact seems to be formed at the glottis, as in *h*oe. There are several glottal consonants in Hebrew and Arabic. The *epiglottis* is passive, without muscles, and it is not an organ of speech, as some have asserted.

159. *The fundamental elements* are the (Latin) vowels U, A, I, and the consonants (mutes) P, T, Cay, corresponding to the *lips, palate* and *throat*, or to the *outer*, *middle* and *inner* parts of the mouth. When the contacts are half open, a series of intermediate consonant sounds result, which may be called liquids. These three kinds are related as represented in the diagram, the *affinities* running vertically, and the analogies horizontally, but as P, T, are equally close, and as A is much more open—more of a vowel than U—the affinity between A and L or R is much less than between U and V, still greater is the distance from A to T, compared with U to P.

Vowels	U	A	I
Liquids	V	L	J
Mutes	P	T	Cay

160. *The primary vowels*, in natural order are

O U A E I, or I E A O U,

and in forming them mechanically, if a tube of a certain length produces U, it must be shortened for O, and so on to I, which requires to be shortened the most. A is the type of the vowels—the natural vowel—and the most agreeable of the whole. Closing the organs from A towards the throat, E and I will be formed: if towards the lips, O and U.

161. *Two complementary vowels* are wanted to occupy the spaces on each side of A, which are greater than those between O U, and between E I. These are *a*we, between A and O, (formed on Faber's speaking machine by touching the O and A keys simultaneously,) and *u*rn on the throat side, between A and E, from the latter of which it is more commonly derived. Some, on the faith of mechanical experiments, locate *u*rn between O and U, thus making it a labial—a view which would vitiate philological deductions. Mr. Ellis would prefer *a*t between A and E.

162. *The secondary vowels* are modifications of the primary and complementary ones, formed by a different aperture, and commonly, but not necessarily short. They occur long, whilst the primaries may become short and abrupt, or staccatoed. Any vowel is here considered secondary whose place is between those already named, as b*i*t, b*e*t, b*a*t, b*o*t, b*u*t, f*u*ll. If n*au*ght and n*o*t differed only in length, the two would constitute but

one vowel, and it is worthy of notice, that whilst the secondary n*o*t has a *closer* aperture than its primary n*au*ght, the secondary th*e*m is more *open* than its primary th*ey*. But this seeming law would disappear with a change in our conventional nomenclature, if, for example, we were to consider f*oo*t the primary and f*oo*l the secondary. The following is a comparison of lip and throat vowels of about the same degree upon each side of the scale:

*o*dd	*a*dd
*o*we	th*e*re
o-bey	th*e*m
. . .	th*ey*
f*oo*l	h*is*
f*oo*t	h*e*

COALESCENTS.

163. *The labial vowel oo*ze readily becomes the consonant *w*ay, and between them there is a shade of sound allied to both, but a variety of the latter, and a consonant, because it has the power of forming a single syllable with a vowel, which two vowels cannot do. Hence to connect I A U into a monosyllable, the extremes must be consonanted, making JAV (yow,) and the result is similar if the order is changed, as in AJV, JVA, &c. Conceiving the coalescents to be vowels, the ancient grammarians adopted the word *diphthong* to account for two vowels forming one syllable. The labial coalescent is represented by *u*, *w*, in English, as in writing—out, house, mouse, (German aus, haus, maus.)

164. *The guttural vowel pique* may become the guttural liquid *y*ea, as in min*i*on, and between the two lies the guttural coalescent in a*i*sle, e*y*e, bo*y*. The consonant relation of the coalescents is shown in the combinations ho*w* *w*ell, m*y* *y*ears, in which it is difficult to tell where the coalescent ends. A comparison of the former (or how-ell) with hâ-well and the latter (or my-ears) with mâ-years, will show their affinity.

165. *A coalescent between vowels* is apt to form a fulcrum by becoming a more complete consonant. Compare (emp)*loyer* with *lawyer*. Hence the Romans, who wrote AE before a consonant in GRÆC-I (Greeks,) used their I consonant when the cay was omitted, or a vowel followed, as in GRAJI (a dissyllable,) for GRÆI.

166. *In English, the guttural coalescent* is preceded by the vowel of *aisle* (varying dialectically to *a*t and *u*p,*) that of *oil*, *boy;* and of *full*, as in *buoy*, pronounced *boo-y* by fishermen, &c., but sometimes corrupted with -oy. The labial coalescent occurs after the same French â of *aisle*, as in *now* (varying dialectically to *a*t, *u*p,) *Faust*, *saur-kraut*. But

*The vowel of *up* is the normal sound according to Wallis, Wilkins, Franklin, Pitman and Ellis. The last uses it concurrently with *ai*, as in *Isaiah*, with *ui* (up) initial, and *ai* (aye) medial, and he says (MS.) that the second syllable of this word is pronounced with *ai* in *ail* "only by dissenting, i. e. non-university clergymen." I was told by Greeks at the Propaganda that in the island of Syra the Catholics say *tyee* or *tshee*, and the schismatics *kyee* for κι—the latter being nearest the true form.

u (you) does not contain it, except where English has been influenced by Belgian and Welsh, and then *u* is read with the initial vowel of *it*, or nearly as *yw* detached from Brand*yw*ine. This is used in New York, and is adopted by Dr. Comstock.

167. *From the superficial analysis* given by the English orthoepists, it is generally impossible to determine whether any particular one placed the consonant of English *u* first (*yoo*,) or last (*iw*,) because the notation was some form of *i-u* or *ee-oo* on both sides; and as the reader was expected to compress them into one syllable, this would be done according to vernacular practice, so that *the same* authority would be cited to justify several modes of pronunciation, and a pronouncing dictionary be the chief means of preventing uniformity by encouraging provincial variation, even among those anxious to conform to some standard. With Antrim, ''twill' (it will) is *too ill;* with Webster and Knowles, 'well' is *oo-el;* Walker, Knowles, and Comstock* make 'coil' identical with *caw ill*, as if *claw-ey* and *cloy* were identic. Yet we have recently heard a child of three and a half years old make the distinction, saying 'boy' for *boy*, and 'bo-y' for *little boy*, using 'girly' as a diminutive in the same sentence. *Bawy* (monosyllable?) for *boy* is given by Halliwell.

168. *Dièresis* is a change from a coalescent to its allied vowel, in pronouncing a diphthong as a dissyllable. It is commonly marked by (¨) two dots—an unphilosophic mode, because the coalescent and the vowel are different elements, each of which should have its letter. The mark may be used to separate syllables, as when *prairie* is pronounced

*"A Treatise on Phonology: comprising a Perfect Alphabet for the English Language; a specimen exhibition of the absurdities of our present system of orthography; Comstock's, Pitman's, and the Cincinnati alphabet, contrasted; a Lecture on Phonetics by Prof. M'Laine; the Pamphoneticon, and recommendations of Comstock's Alphabet. By Andrew Comstock, M. D., second edition, Philadelphia, 1855.

a. This work contains about thirty pages of recommendations from clergymen, editors, superintendents and controllers of public education, college professors, &c. These recommendations are valuable, as showing the extent to which the *educated classes* of the United States are dissatisfied with the ordinary mode of spelling English. They say in a note—"We do not here wish to be understood as referring to Pitman's *Short Hand* Alphabet. His *Phonography* as he calls it, though not strictly *phonetic*, is admitted to be the best system of short hand which has yet been devised."

b. The author says (p. 15)—"If the Roman alphabet be taken as a basis on which to found a phonetic alphabet, its letters should be so appropriated that they may be conveniently used in all the languages in which the Roman alphabet is employed. This has been done in the present instance: for the author was aware that if his alphabet were not so construed as to suit the European languages, *it would not be adapted to the English language.* Every linguist must see this."

c. Unfortunately, whilst he uses e in *they* and ɛ in *them* correctly, he has new characters for the vowels of *field*, *filled;* he perverts I to *ai* in *aisle*, C to *sh*, J to *zh*, and Q to *wh;* and he uses U as in *full*, u in *up*, and O in *on*.

d. Alphabets of this kind show that when authors depart from the Latin and true etymologic basis, there can be no agreement upon the amount or kind of corruption which shall be sanctioned, because there can be no rule formed which shall justify *mine* and condemn *yours*—adopt certain double letters proposed by *me*, and reject such as *you* propose. Thus Dr. Comstock intimates (p. 59) that the Italians will never discard A, yet he does not hesitate to deprive them of I.

pr¨airie in three syllables, or *road* dilated into r¨ode, making *summerode* (sumr¨ode,) out of *some road*, su¨dnly or sud¨nly out of sudn¨ly, prism¨atic out of pri¨smatic, &c. The words batl¨ing, butn¨ing, have three syllables, and ban¨tling two, but most persons would write the latter bant¨ling, guided by the etymologic rather than the phonetic syllabication. In these cases the separating mark is required but once, because *sudn* cannot be made a monosyllable as long as 'n' is *n*.

169. *The finals* in batl, batr, banr, sudn, prism, &c., are not essentially different, (*l*, *r*, have more aperture,) from those of *fall*, *bar*, *den*, *aim*, and they do not require to be marked to indicate the formation of syllable without vowels, except in rare cases, as in § 168. The Grebo has a word *m* (five,) Chinese has *m* (aunt) and *ng* (five) as in *sing*, and if we write *may* and *aim* with 'm' why not *m* with the *ay* or (*ai*) omitted? Bohemian has consonant syllables, as drt *sawdust*, smrt *death*, blk *fire*, blb *a clown*, frk *foam*, &c.

170. *The following are old Nordish*—akr *acre*, backstr *a baking* (a proper name in English,) aftr *after*, fīngr *finger*, bitr *biting*, eign *own*, gagn *gain*, gegn *against*, öxl *shoulder*, öxn *oxen*, āvalr *bowed*, fullr *full*, greipr *crooked*, armr *arm*, flatr *flat*, arligr *early*, and many more, which would probably be admitted as English forms, were it not that grammarians have been accustomed to use the note of exclamation when discussing syllables without vowels. This, and poetic orthographies like Heav'n, sev'n (which no writing can monosyllabise,) may have fostered the use of the apostrophe, as if there were something present in the nature of a vowel. But that something (*n* or *vn*) is equally present in *nv*, *nva*, *vna*.

171. *But this attention to syllables* is neglected in the dissyllables pat, tap, the final unwritten breath of which (pa-t^{c}, tap^{c}, bad^{c}, bug^{kc},) makes a syllable with the antecedent consonant, a fact which is partially recognised by the more rhythmic and delicate French ear. The Chinese word for *six* is precisely the English word *luck*, but it is a monosyllable, the breath being retained by the closed organs, making luck^{c}.—*Hald.*, Proceedings of the Am. Acad., 1842, p. 175.

172. *Synèresis* is the change of a guttural or labial vowel into a coalescent. It is usually regarded as the union of two vowels into a diphthong, which implies an impossibility. It may be indicated by (¨) a reversed dièresis mark, as in the Latin PENNA¨E, with the dots superimposed. The coalescent letters should be formed on a consonant basis, as in A¨JL for *aisle*, and A¨VL for *owl*. A consonant basis will give to languages like Latin and Greek, *a vowel to every syllable.*

173. *The separation of the coalescents* from the vowels, being quite modern, their difference is seldom recognised in alphabets. *This is a grave defect.*

CONSONANTS.

174. *If the lips are partially closed* from the U *oo* position, we get the aperture for the initial of *way*, represented by *w* in English, V in Latin, and *u* in Italian and Spanish. It does not occur in German, and has a doubtful place in French; where, according to Olivier, (Sons de la Parole, p. 171,) it occurs *in careless speech*, in the words *oui, ouest, ouate.* Being half interrupted, we will call it a liquid. It has an audible sound, so that it is also sonant.

175. *If we give w an accession* of breath, unaccompanied by voice (the vocal ligaments not being parallel,) it will become *wh*, which has the qualities named *surd* (from its want of vocality) and aspirate, from its hissing sound. The Romans applied the term LENIS (soft) to the quality of an unaspirate consonant. (This and several allied terms are adopted from Latham.) If, instead of forming the liquid *way*, the lips be closed upon the issuing voice, the sonant *bay* will result if the voice is heard, and the surd *pay* if it is checked.

176. *If the ventages of a clarinet* are stopped, and the end or bell be suddenly closed upon the issuing sound, the vibration is checked; and if the vocal passage were made of an unyielding material, *b, d,* and *gay could not be formed*, as the close of the organs would prevent the passage of air over the vocal ligaments. The absence or rarity of these sounds in some languages may be due to rigidity in the organs of speech.*

177. *The word 'surd' nearly corresponds* to whispered, but is distinct. In whispering, the murmur of breath through the larynx is heard, and if *b* is the whispered element, it continues until the mouth is filled with air, whilst *p* is not continuous, the organs being rigid. In whispering vowels, the organs are in the normal speaking condition, except that the vocal ligaments are not allowed to become parallel.

178. *A sonant element often indicates* a verb in English, and its surd a noun, as in prove proof; breathe breath; live life; braze brass; ūse ŭse; refūse rĕfuse. Hence, when *hold* is a noun, it is popularly pronounced *holt*, and *hilt* is authorised.

179. *Sonant elements being longer* than surd ones, the length is in some degree transferred to a preceding vowel, as in rōad rŏte; bōne bŏat; bāde băte; lēague lĕek; rōbe rŏpe; in which *bait* and *leek* are as short as *bat* and *lick.*

180. *On account of the additional effort* required to make the vocal ligaments parallel, and perhaps to furnish breath for *b, d, gay*, beyond what is required for *p, t, cay*, the latter must be considered the most typical, natural, and the earlier. But Grimm, (Geschichte der Deutschen Sprache, 1853, chap. xv.) gives the preference to *b, d, gay.*

* As the mouth of speaking birds is unlike that of man, it is probable that the absence of articulation in the apes is not due to the anatomical peculiarities commonly mentioned, but to the want of *a speaking brain* to guide the tongue and lips toward articulation, as the hand is guided in the imitation of human actions. We have promulgated this view in lectures and among cultivators of science for twenty or twenty-five years.

181. *The effort to produce vocality* may perhaps be transferred from the glottis to the contacts, so that instead of *b, d, gay,* a modified *p, t, cay* will occur, made with the points of contact (as the lips) flattened against each other, producing what we call a *flat* sound —to be indicated by heavier-faced (**p**, **t**, **c**,) types. They occur in German, in the aboriginal languages of America, as Cherokee, and we place the **t** in the Arabic word Vâhɛ**t** (one.) The ear takes cognizance of the sound, and the German word **t**od (death,) perhaps differs as much from the English *toad* as their syllable *will* differs from *will;* but the Englishman and Frenchman think the effect a kind of *d*.* *D, t,* (b p, g c,) *are* in fact often confounded, but the explanation given here is based upon a vernacular acquaintance with the phenomenon.

182. *That the flat p, t, cay do not require* more force of breath than *p, t, cay,* may be thus proved. Take a tubulate retort holding about half a pint, and partly filled with water; let the stopper be replaced with a glass tube passed through a perforated cork; then by blowing through the neck, the water will rise in the tube, and indicate the amount of pressure, and this we have found to be about the same for the two kinds of *p*. The apparatus may be varied by inserting two tubes through the cork of a bottle, one of them bent at right angles, or made of gum.

183. *If a slight crevice* is left between the lips in closing to *b,* the result is the Spanish *b* between vowels, as in Còrdŏbă, a sound associated with 'w' in German, where the orthography would be *Cordowa.* If this *bh* is made surd, it becomes Greek *phi.* If instead of the lips, the lower lip and upper teeth are used, we get English *v,* or if surd, English and Latin *f* will be formed.

184. *The quality of ph, f, &c. is aspirate, of bh, v, &c. vocal aspirate,* but as some view this as a contradiction of terms, *spirant* (Rapp's term) may be used instead.† Nevertheless, if *f* or *s* is alternately made *v* or *z,* an attentive ear can distinguish the hiss of the former through the vocality of the latter.

185. *It is not possible to breathe* when the organs are in the *b, p,* position, because the nasal passage is closed by the palatal veil: if this be opened, as in breathing, and voice

* "Whence is it that the Spaniards and Gascons confound *b* with *v*, that the Germans scarcely distinguish between *k* and *g* hard, *d* and *t*, *b* and *p*, and that in their orthography they often use one or other indifferently?

"We once had a long discussion with an educated Iroquois, to determine whether a certain sound of his language was *k* or *g* hard, whether one should pronounce *Ganadayé* (village) or *Kanadayé*. The discussion was long, and we finally decided in favor of *k*. . . The missionaries used these letters indifferently in their printed books. Zeisberger frankly admits in his Lénâpé [Lɛnāpɛ] primer, that his printer, running short of *k*, was obliged to substitute *g*. Zeisberger was a German."—*Duponceau,* Mém. sur le Syst. Grammat. des Langues Indiennes. Paris, 1838, p. 99, 100.

† Wilkins (Real Character, London, 1668, p. 367,) uses the term *incrassated*. This table of the elements, p. 358, is worthy of examination.

be emitted, the result is a nasal *b*, that is, an *m;* and if *m* be treated like *w* to produce *wh, surd aspirate mh* will result, heard in what Dr. Rush calls the "symbol of a sneer," and written *hem!* in English, and *hm* in German. But this aspirate *m* is followed by a true sonant *m* (*mhm*) as *wh* in English is always followed by a true *w, when* being made up of the four sounds wh-w-e-n. See § 41 *a*, 4th paradox. To this *mhm* Lepsius (Alphabet p. 27) wrongly assigns the vowel in *up,* with its resonance "lost by partially contracting the mouth or *even closing it entirely,* in the latter case it is heard through the nose." He would mark it with a minute circle below *m,* probably the final one—or both.

NOTATION OF NASALITY.

186. *Nasal vowels and consonants do not differ* more than their pure originals differ. The Latin final in TAM, TUM, was not M, but a nasal sign for the vowels, Verrius Flaccus wrote it with half its letter N. It is sometimes omitted in Inscriptions, and Manutius (Orthographiae Ratio, Venetiis, 1566, p. 143,) gives an inscription beginning with the line—

LVXURIANTE̅ . ANIMO̅ . POENU̅

where the 'm' is indicated by a superior line, the small letters e, u, being probably used because marked capitals were wanting. This is common in old printing as in "—durabit mundus sub Meschia duob. millibus annorū, and postea reuertetur ad informē suā speciē." *Sebastian Munster,* Evang. Hebr. Lat. Basileæ, 1582, p. 66. The old printers used it for *n* also. The Portuguese adopted this notation, as in õ, and it is used by Rapp and Lepsius; italic *m* is used by Max Müller, as in a*m;* which Ellis would write an *aa,* or aA; Eichhoff AN the *n* finishing with a minute circle; Féline Ekritur Fonetik, Paris, 1852, a̲.

187. *A consonant is suggested* by forms like a*n,* a*m,* where the effect is strictly a vowel; and they indicate a local etymology, which is as bad as writing no*ch*t for *not;* for *in many languages nasal vowels cannot be traced to an antecedent consonant.* The missionary—says Max Müller, p. xx, lxxxi, "should be guided entirely by ear, without paying any regard to etymological considerations, which are too apt to mislead even the most accomplished scholar." "In a first attempt to fix a spoken language. . . . the writer should not be swayed by any hasty etymological considerations."*

188. *The indication of nasality* by a superior (˜) usurps the space which some will require for the marks of length, and others for accentuals; and every nasal thus marked

* Of course then we cannot write *au* for *o* with Eichhoff, to accommodate a Sanscrit phase; nor *ai* for French ê with Volney (Simplification, p. 41,) for the "precious advantage" of representing certain Arabic plurals by reversing the characters, as in *dair* a house, *diâr* houses. This would be paralleled in music, by writing the notes CG instead of the intermediate E.

requires an additional type. Duponceau preferred the Polish mode, which arose out of the early Latin typography, in which a flourish was sometimes thrown down, and towards the right, much like an inverted comma point. This point will be used in these pages, producing forms like i_{ϵ} e_{ϵ} a_{ϵ} o_{ϵ} u_{ϵ} y_{ϵ} &c.

189. *If a nasal vowel* is properly represented by an ordinary vowel character and a nasal sign, the notation of *m* and *n* is unphilosophic, but not that of *ng* (except in its duplicity,) if the *n* is a nasal sign to the *gay*. If $su^{n}g$ (su_{G}) spells *sung*, $su^{n}d$ (sud_{ϵ}) is *sun*, and $su^{n}b$ (sub_{ϵ}) is *sum;* or if $b\tilde{o}$, bo_{ϵ} are the French *bon*, $\tilde{B}\,\tilde{o}$, $b_{\epsilon}o_{\epsilon}$ are *mon*.

190. *An analysis of the system* of articulate sounds requires that the possible amount of consonant variation should be determined, and this will be attempted for the labials (the action of the lips being most readily identified by touch and sight,) after which the results can be applied to other parts of the vocal organism.

191. *This inquiry has important bearings* on the investigation of languages, because the theoretic knowledge that a sound is possible, will assist us in identifying it from the obscurities of imperfect description. *a.* Thus the accounts which the ancient grammarians give of their *phi* are sufficiently clear to the modern who has inferred the existence of such a sound; (*b.*) and the relations of a peculiar Albanian sonant aspirate *n*, (No. 2 of the scheme § 193*a.*, 483,) were detected when the sound was heard in nature.

192. *Six phases have been mentioned*, surd and sonant, lenis and aspirate, oral and nasal. Several of these may occur simultaneously, but not surd and sonant, nor (in most cases) lenis and aspirate. In the common alphabet, when b is surd, it is written p, but surd or whispered *w* or *m* cannot be represented; and whilst *h* in *bh* does not destroy the vocality of *b*, it renders *mh*, *rh*, *lh*, surd. We want, therefore, the means of representing sonant and surd, independently of aspiration. In the examples to be given in the sequel, the Greek aspiration and accent marks will be used together, but the latter should be filed away to a uniform thickness, to distinguish them from accent marks, which are tapering. Thus

ˣ	means	lenis-surd,
ᵊ	"	aspirate-surd,
ˢ	"	lenis-sonant.
ᵃ	"	aspirate-sonant.
ʿ	"	aspiration through the mouth, as ʿl for lh.
ʿ	"	aspiration through the nose, as ʿm for mh.
ʿʿ	"	" through nose and mouth simultaneously.

193. *The following scheme* indicates *eight* mutes and as many possible liquids; eight lenis forms, each of which may be aspirated; eight that are pure or oral, each of which

may be nasalised; and eight sonants, each of which may be voiceless. To these might be added the coalescents as modified by nasality, aspiration, or whisper. To prevent confusion from so many minute marks, the lenis are here neglected, and the sonant and surd phases have the additional indication of heavy and light letters respectively.

193 *a*. SCHEME OF CONSONANT PHASES.

INTERRUPTION.	little	nasal	sonant	lenis	1	w_{ϵ}	. . . .	l_{ϵ}	. . . .	r_{ϵ}
				asper	2	$^{\sigma}w_{\epsilon}$	. . . .	$^{\sigma}l_{\epsilon}$		
			surd	lenis	3	w_{ϵ}	. . . .	l_{ϵ}		
				asper	4	$^{\sigma}w_{\epsilon}$	. . . .	$^{\sigma}l_{\epsilon}$		
		pure	sonant	lenis	5	w_{ϵ}	. . . .	l	. . . .	r
				asper	6	$^{\sigma}w_{\epsilon}$	. . . .	lh	. . . .	rh
			surd	lenis	7	w_{ϵ}	. . . .	l	. . . .	r
				asper	8	$^{\sigma}w_{\epsilon}$ = wh	. .	lh	. . . .	rh
	much	nasal	sonant	lenis	1′	b_{ϵ} = m		n	. . . .	Ꮑ?
				asper	2′	$^{\sigma}b_{\epsilon}$ =(‘m)		‘n Albanian.		
			surd	lenis	3′	p_{ϵ} = m		n		
				asper	4′	$^{\sigma}p_{\epsilon}$ =(‘m)		‘n Cherokee.		
		pure	sonant	lenis	5′	b	. . . .	d		
				asper	6′	$^{\sigma}b$	. . dh		. . . .	z
			surd	lenis	7′	p	. . . .	t		
				asper	8′	$^{\sigma}p$ = φ	th		. . . .	s

194. *We are here shown*, that however proper “ph” and “th” may be to indicate a kind of *h* modified at the points *p* and *t*, this notation is entirely inappropriate in *mh;* for as *ph* breaks the labial barrier of *p*, *mh* should do the same for the nasal element *m*. Producing a sound modified by air passing from the lips, *mh* should mean (v_{ϵ}) a nasal *v*, or rather, a nasal German *w*, for *m* means a nasal, and *h* a mouth aspiration of it. B_{ϵ} is strictly *m*, p_{ϵ} the same (ˇm) whispered, ‘m does not distinguish between sonant and surd, nor bh_{ϵ} or $^{\prime}b_{\epsilon}$ between oral and nasal. The latter might be read with the lips closed or open, if not restricted to an oral phase.

195. *We require an aspiration mark* for the mouth, as employed in the Greek *ῥ*, and another (‘) for the nasal phase, which we will name *afflatus*, this being one of the Latin terms for aspiration. In the preceding scheme, mute 2′ is a sonant nasal aspirate; and were the aspirate mark inverted (‘) it would be equivalent to ‘m sonant afflate. But the increased breath necessary to aspirate the former would drive the air through the nostrils, so that in most cases there would be both aspiration and afflatus.

196. *Theoretic elements*, like nasal bh, ph, v, f, lh, rh, would probably be inconvenient in speech, on account of the effort required to drive voice or breath through the two apertures, and the nice adaptation of mouth to distribute the current between the two. *a*. It is worthy of remark, that when the liquids and nasal mutes are surd, they are likely to become aspirate.

197. *The liquids do not include* the nasal mutes *m, n, ng,* although on a cursory view, a table like the following, which would associate *l, m, n, r,* would satisfy most grammarians.

Voice Interrupted, { little, { liquids, w, l, r, y. nasals, m, n, (r꞉) ng. ; much, mutes, p, b, f, t, &c. }

This is incorrect, because, if *n* as a nasal *d,* is to be thrown out of the mutes into another division, we must throw a nasal *l* out of the liquids to form still another. For the existence or non-existence of such an *l* in nature, has nothing to do with the question of arrangement. But Medhurst (Dict. p. xxxii) mentions such a sound in Chinese—"when it is joined to a nasal final, the power of the *l* is in a great measure merged in the nasal, in which case it acquires a sound something similar to *n*." This l꞉ is liquid No. 1 in the scheme. "*Kw*ⁿ*a* is the same with the 20th final *kwa,* only pronounced with a strong nasal termination, as if written *koo-w*ⁿ*a*." Medhurst p. xxxv. This seems to be w꞉ No. 1 of the scheme. Böhtlingk mentions a nasal of German J. Compare Albanian nj꞉ĭ꞉ (one) a nasal syllable.

198. *In the dental column,* No. 6 is a vocal aspirate lh, which we attribute provisionally to Irish, its surd cognate being in Welsh. In the next column there is a Sanscrit letter which should probably be located farther back than *r, s.* It may have been a French *j* nasal afflate (ʒ꞉) No. 2 of the palatal contact.

199. *According to the description* of Sir Wm. Jones,* the cerebral *D* can hardly be a pure mute, for—"When the tongue is inverted with a slight vibratory motion, it has a mixture of the ra, with which it is often, but incorrectly confounded." Colonel Vans Kennedy† observes that cerebral *T* "is peculiar to the Sanscrit alphabet, and in sound partakes of *d* and *r*." The effect of such a sound would recall a vocal sonant untrilled *r,* but with Mr. Ellis, we think these descriptions unsatisfactory.

* On the Orthography of Asiatick words, Asiatic Researches, London 1801, vol. 1. The following is an extract from p. 33:—"Agreeably to the preceding analysis of letters, if I were to adopt a new mode of *English* orthography, I should write Addison's description of the angel in the following manner, distinguishing the *simple breathing,* or first elements, which we cannot invariably omit, by a perpendicular line over the first or second vowel." (In 'sm' for *some,* and 'sch' *such,* the vowel is understood after s, as in Sanscrit.)

"So hwen sm énjel, bai divain cămánd
Widh raisin tempests shécs a gilti land,
Sch az ăv lét ór pél Britanya pást,
Cálm and sirín hi draivz dhi fyúryas blást,
And, plíz'd dh' ālmaitiz ārders tu perfórm,
Raids in dhi hwerlwind and dairects dhi stārm."

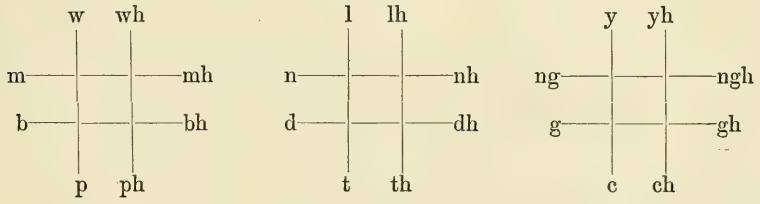
†The same author thinks that Sanscrit *dzh, tsh,* becoming y, and that *sh* became Greek *k* and Persian *kh*—thus taking, as we believe, the younger for the older, and reversing the course of the transmutation.

200. *If Welsh rh is made sonant,* it will bear considerable resemblance to Slavonic *rz** which, in Bohemian is both sonant and surd, although unacknowledged. It is a trilled *r* with a concurrent buz very like French *j*—itself the aspirate of some variety of *d*. The hypothesis is here offered, that this sound is due to an attempt to vocalise *rh*, and it is acknowledged to be a philologic analogue of *r*, as in Polish, Rzym *Rome,* Bohemian, R^{v}egor^{v} *Gregory,* Bedr^{v}ich *Frederic.*

201. *In the consonant scheme* of the Penny Cyclopædia, (1833, Vol. I, p. 380, by Prof. T. H. Key,) b, bh, p, ph, are arranged around the bottom of a cube, one at each angle; the dentals around the middle, and the gutturals around the top; so that *d* is above *b*, and *cay* above *d*, the letters on the angles being

b	p	d	t	g	c
bh	ph	dh	th	gh	ch = χ

The silibants are arranged in an independent class, and the "liquids" *r, l, m, n,*—a very objectionable arrangement, for the omitted *wh* and *ng* are as important as *ph* and *n;* and *ph, f, th, s, sh,* form a regular gradation of aspirates going back from the lips. An octagonal figure would have given several better arrangements, of which the following is one—



* A fact first noticed (Jan. 29th, 1858,) whilst constructing the foregoing scheme for this essay, and trying the vocal effect of its constituents. Mr. Ellis (MS.) calls attention to the following relations, the sounds represented above *z* and *zh* being sonant—

rh	*rh*	*srh*	*zrh*
s	*z*	*sh*	*zh*

CHAPTER IX.

PHASES OF WORDS.

Copious even to excess, as is the literary labor of our age, and ever seeking new topics, new methods of verifying old ones; there are yet subjects to be found, either not touched upon at all, or scantily and incidentally treated, without due regard to their proper value. In the great domain of natural history and the physical sciences, the rapid growth of knowledge, and its subjection to new laws and generalisations, have created the need of *fresh divisions* in every part; of *altered nomenclature*, and *particular treatises* on topics, the increasing importance of which compels this separation.—*Edinburgh Review.*

202. *The elements thus far discussed* afford sufficient material for an elucidation of the mode of their employment in speech, and the causes which influence the physiognomy of words. Several chapters will now be devoted to the phonetic and etymologic subject of the Phases of Words. *There are four phases of words—Metáthesis,* or transposition; *Epénthesis,* or increase; *E'cthesis,* or elision; and *Anáthesis,* or mutation.

METATHESIS.

203. *Rapidity of utterance requires* that in pronouncing the sequents LA, LI, PL-, PR-, the cavity of the mouth must be set for A, I, before the L is formed, and the tongue be placed for L, R, before the P is formed, as in saying pl-ay, ta-bl; pr-ay, ta-pr. This may cause the elements to be displaced, that which should be last getting the first place, by a *physical* process. This is partially recognised in Sanscrit orthography, where *tig* (to strike) is written with the vowel character preceding that for *t*, as if *itg*, but read *tig*.

204. *The mental image of a word* being a whole, and its broken elements and syllables a succession of parts, these may be confounded in the emission by a *mental* process—an accident of a kind which sometimes happens in writing. We adopt the mark (×) used by Dr. Tschirschnitz* to indicate metathesis. The following are examples: Ang. brid, a bird; acsian and ascian, to ask; Eng. dial. gers, grass.

Croatian,	strok	krap	mleko	brada.
	×	×	×	×
English,	stork	carp	milk	beard.

EPENTHESIS.

205. *Epenthesis is the lengthening* of a word, as by the use of affixes, whether prefixes or suffixes. *Ne-ar* is an old comparative meaning *more nigh,* but the suffix being forgotten, the word acquired a positive sense, with a double comparative in ne-ar-er. In old high German, sacc-lin-chin is a double diminutive of sack; and esel-in-chi-l-in may be a triple

* Natûrkunde der ſprâchlaute dârstellend das wörterreich der deütschen ſprache nâch lauten und begriffen natûrwissenschaftlich begründet und geordnet. Breslau, 1841. 300 pp. 8vo.

or quadruple diminutive of *ass*, although it is more probable that *in* (in one or both cases) is a feminine sign.

206. *A consonant is sometimes inserted* as a fulcrum between vowels, as in witti-c-ism, ego-t-ism, *μη-κ-έτι*, or a vowel between consonants, as in the Hauaian piladel-e-pia for Philade*lph*ia. Among the causes of epenthesis are *cyclesis, eduction*, and *induction*. Other causes will be mentioned in later chapters.

CYCLESIS.

207. *In withdrawing the tongue from the palate*, if it is done with a cycloidal motion, like unrolling it from the tip backwards, *t* may be followed by an inserted *s*, as in German, or by *sh*, as in English; and *d* may be followed by English *z*, as in Italian, or by French *j*. Germans and Italians are so accustomed to it that they corrupt Latin with an imaginary *s* after pure *t* in words like nāt-i-o (nation,) lēct-i-o (a choosing,) reading *natsio* and *lectsio*.

EDUCTION.

208. *As the opening of the nasal passage* turns D into N, if in saying *ten* this passage is closed before the voice is stopped, 'tend' will result; and from tĕnĕr and gĕnŭs (gĕnĕr-is,) tender and gender are formed by the eduction of *d* from *u*. In lantern from lātērnă, the nasal passage is allowed to open before the *t*, forming *n*, as *b* gives rise to *m* in străbo, Ital. strambo. Other examples are, number, tremble, lend, salt, thimble, remember, contempt, consumption. Latin hŭMĭLĭs, Eng. humble, Spanish humilde. In the French pivoine, *v* is educed from *o;* and CAMPHORA gives the German kampfer by *eduction*, and the Slavonic ka*f*er by the *absorption* of *m*. German pfeffer (pepper,) pfad (path,) &c. Greek Sappho, Bacchus, Matthew.

209. *Educed elements are not inserted* in the sense that *n* is inserted in AlbaNcella, anciently Albocella; or the *d* in a(d)vance, or *r* in t(r)easury, vag(r)ant, Ta(r)tar, as these are not due to the mechanical action of the organs.

210. *In examining Spanish*, we find I introduced in a few words, as in *viento* (wind,) from vēntŭs. If we compare Spanish words in ve- with those in vi-, we find that the latter exceed the former somewhat in number, so that the change might be attributed to the influence or *induction* of a larger upon a smaller class. But on comparing other Spanish words, as *tiempo* (time,) from tēmpŭs; *piel* from pēllĭs (a skin;) *diente* from dēntĭs (of a tooth;) we find that the forms in te-, pe-, de-, greatly exceed those in ti-, pi-, di-.

211. *In forming the syllable* PE-, if the mouth be not set soon enough for the E, the aperture will be that of I, which sound will be interposed (as in these examples) as an eduction from E. In the same manner, on the labial side of the vowel scale, U is educed from O, as in passing from Latin to Italian in sŏnus *suono* (sound,) sŏrŏr *suore* (sister,)

hŏmo *uomo* (man.) In nŏvus *nuovo* (new,) the Spanish form is *nuevo*, where, after the eduction, the O passed by transcession to E. Compare cōrpŭs *cuerpo*, bŏnus *bueno*, ┼ FONTE* *fuente*. In cŏrĭūm (a hide,) Italian *cuojo*, U is educed from O, *r* is elided, and *i* closes to its liquid congener.

212. *Eduction may preserve the length of a word*, and be spontaneously used for this purpose when the loss of a consonant would shorten it, as in Latin ┼ CORDE (heart) Italian *cuore;* CORIUM *cuojo*, &c.

213. *The French inverse diphthong oi* probably arose eductively after labials, as in *poire* (pear,) which is nearly *pwar*, or in Latin letters PV'AR; *voie* (a road,) *pois* (pea, *s* silent,) *quoi* (what,) *moine* (monk,) *moins* (less,) =MV'I, with *a* in *at* nasal; *bois* (wood,) *foie* (liver.) After being thus formed, the use of this *oi* would be extended, as in *oindre* (to anoint,) =V'I,DR̃; *croitre* (to grow,) =CRV'ATR̃.†

INDUCTION.

214. *Induction is the influence* of larger classes of words upon smaller ones, causing uniformity, and regularity in grammatic inflections. It may lengthen, shorten, or otherwise vary words. Thus *clift* is formed from *cliff* by the induction of words like *lift*, *drift*, which exceed those in *-iff*. Similarly, the -tion termination carries with it *ocean* and *physician;* -idge of carriage, marriage, porridge, controls the old English -age termination once heard in selvage, garbage, baggage, privilege, &c., and dotard, wisard, &c., have induced Spaniar*d*, and the vulgar scholar*d*.

215. *Italian prefers English y* to *l* in certain places, and introduces it instead, as in plūmbū^{m} (lead) *piombo;* plănus (plain) *piāno*, Spanish *llano* (LJANO, dropping *p*,) Neapolitan *chiano*, with a *cay*, not transmuted from the *p* of *piano*, but educed from the J.

216. *Alliteration is a variety of induction* in which an element suggests its repetition, as in pēRdīx, Fr. pe*rd*rix, Eng. pa*rt*ridge; Latin amiTa, Fr. *ta^{n}te*; Eng. pitapat, slipslop, &c.

217. *Reduplication* is a variety of alliteration common in Greek, and less so in Latin.

218. *There is an apparent interchange* of initial E and S between French and English, which cannot be accounted for on any theory of the elements. It occurs in

étrange	épagneul	épeler	ete^{n}dard	écosse
strange	spaniel	spell	standard	scotland

* It is often necessary to use and indicate the inflection of a word, and a mark (┼) will be adopted for this purpose, in which the little directing branch is directed towards the *graph* (glyph) or written word. Dialectic forms will be marked with (┤) an allied figure, the directing mark being turned away, as in *curds*, ┤*cruds*. It is often inconvenient to give the meanings of illustrative words, and deceptive to allow one meaning to stand for several cognates, hence the mark (┘) will indicate that the meaning of several cognates is not quite identic, as in *beam*, German ┘*baum*—meaning *tree*. These marks are made from the dagger of the printers.

† This view, that *o* in *oie* is a coalescent, wants confirmation, as, from want of opportunity, it has not been examined in nature for ten years.

In comparing the first pair with the Latin original ēxtrānĕus, we find that *es* of EX has been elided from the French, and *ec* from the English form, so that this apparent interchange is an example of *elision*. But this will not account for the next forms.

219. *In Spanish* (which differs from Italian in this feature) initial S is not followed by some consonants (f, p, v, m, l, n, d, g, c, q); but as *es* followed by *c* &c. is a common initial combination, there is a feeling that the initial S in SC-, &c., ought to make a distinct syllable, a feeling which is realised by prefixing *e-*, whence † scōrpĭōn-ĭs became *escorpion*, spĕcĭēs *especie*, &c.

220. *This incompatibility* of certain sequents occurs to a less extent in French, in which, although words commencing with sp-, sc-, st-, exist, there is a tendency to prefix E-, forming ésp-, ésc-, ést-, and the syllable being attained, the next tendency is to get rid of the S, which was an unstable element, even in Latin. This accounts for the following French forms, none of which are examples of a transmutation of S to E.

spĕcĭēs	stŏmăchus	spīrĭtus	stăbulū^{m}
espèce	estomac	esprit	é..table

Hungarian has *o* similarly prefixed in *ostoba* (stupid) and *oskola* (school,) adapted from the Latin.

CHAPTER X.

ELISION.

Such a renovation and extension of the reform of philosophy appears to belong peculiarly to our own time. We may discern no few or doubtful presages of its approach; and an attempt to give form and connexion to the elements of such a scheme cannot now be considered premature.—*Whewell*, Pref. to Hist. of the Inductive Sciences.

§ 221. *Elision is a prominent agent* in breaking up by an *organic* process, the forms of words as built up by a *mental* process, and it causes much difficulty in etymologic investigations. In English it causes *al* to mean an *awl* and an *eel*, by reducing the Latin AcuLa and AngvīLla to the same dimensions. The German *zettel* (= tsɛtl) as a *note* or billet, is cut down from sCIDuLa, and as the *chain* or warp in weaving—from CATEnuLa a little (cătēnă) chain, preserved also in the German *kette*.

222. *Some nations reject* parts of words which others retain, causing differences in languages of the same stock, as Welsh and Irish. The English *four*, Welsh pédwar (*e* in *met*, Eng. *w*) and Irish cáthar (each *a* in *at*,) bear so little resemblance to each other, that without their history, it would be rash to consider them cognates. They are, moreover, cited

erroneously for the transmutation of *cay* and *p*, as Italian *piano* and Neapolitan *chiano* (kiano, § 215) might be cited for the same purpose.* The English triliteral FOR *four*, stands in the Latin QVATUOR; Welsh takes a different portion—QVATVOR; whilst Irish claims the initial—QvATvOR.

223. *The Latin* QVINQVE *is older* than the Sanscrit and Zend *pantshan* (five.) It gives the Welsh *pymp*, Aeolic Greek πέμπε (by turning N to M through the influence of P formed from V,) and πέντε, probably the newer form. QVINQVE also gives the Irish *cuig* (as in *coo*, *ig*-nite,) which on account of retaining both gutturals, is purer than the Welsh and Greek forms. These relations will appear in the following tables, where ʃ is to be read as English *sh*.

Latin	Q V A T U O R	Q V I N Q V E
Irish	c .. a θ .. a r	c u i .. g .. ..
Lithuanian . . .	k .. e t u .. r i	.. p e n k .. i
Ceylonese	h .. a t .. a r ay	.. p a .. h .. ay
Sanscrit	tʃ .. a t u a r	.. p a ̥ .. tʃ .. an
Armenian	tʃ .. .. .. ŭ ŏ r .. s	h .. ĭ ŋ c .. ..
Persian	tʃ .. ă h .. a r ..	.. p e n tʃ .. ..
Bengalee	tʃ .. ā .. .. .. r ĭ	.. p a ̥ .. tʃ .. ..
Wallachian . . .	.. p ā t .. .. r ŭ	tʃ .. ĭ n tʃ .. ..
Welsh	.. p e d w a r ..	.. p y m .. p ..
Gothic	.. f i d v o r ..	.. f i m .. f ..
Greek	†τ .. έ ττ .. α ρ ε ς	.. π έ μ .. π ε
"	†.. π ί σ υ .. ρ ε ς	.. π έ ν τ .. ε
Albanian	c .. ā t .. .. r ..	.. p ɛ̣ .. s .. ..
Oscan	.. P E T .. O R A	.. P O M T .. I S
Old French . . .	.. p e t .. o r	Fr. c .. i^{n} .. q

224. *The Latin is the oldest* of these forms of *four*, and next the Irish and Lithuanian. The Sanscrit form is old only in its vowels, in which it is equalled by the modern Persian, which has an anomalous *h* probably arising from a transmutation of aspirates. Of *five*, the Latin form is the oldest, and next the Irish and Lithuanian. The Lithuanian *keturi* (four) takes the *guttural* in the first syllable, like the Irish, and in the second the labial,

* "The interchange of *s* with *h*, and of *k* with *p*, are the most striking cases. . . . There are scarcely any words in Irish which begin with *p*, . . . and it is no less observable, that a considerable number of these words, whose initial in the British language is a *p*, begin in Irish with a *k*, or as they constantly write it, with a *c*."—*Winning's* Manual of Comparative Philology, London, 1838, p. 128–9.

† For the transmutation of *cay* to *t*, compare Doric Τεῖνος, Ionic Κεῖνος (he, that;) Latin PASCERE, French paiTre, to pasture. The Pehlvi, Hindustani, Deccan, Gudzherat, Mahratta, and Gipsy forms, closely resemble the Persian.

like the Welsh. In the first syllable of *penki* (five) it takes the labial with the Welsh, and in the second the guttural with the Irish.*

225. *The Latin* QVI (who) is *pwy* in Welsh (with *p* educed from *w*,) and CI in Irish, Persian, Turkish, Hungarian, French (qui,) and Italian (chi.) Latin EQ..VUS, CAB-ALLUS (horse) Welsh *eb-ol*, English *cob*, Gr. ἵππος and ἵκκος, Irish ăch. The Latin ăqvă gives the Sanscrit *ăp*, the Rhaetian and local Spanish *aua*, the Austrian *ach*, Lettish *akka* and Welsh *ach* and *aw*. The Sanscrit *prat'hamas* (first) gives the Greek πρῶτος and Latin PRIMUS: and Latin TEMPUS gives to English *time* and *tense* (through old French *temps*,) the *m* being assimilated to *n* by the influence of *s*.

226. *In comparing Latin and its cognate* the ancient Oscan, we find that the latter rejected the guttural in similar cases, and used P instead of V;—NEQUE nep; QVOS pus; QVAM pam; QVIDDAM pidum; QVIS pis; QVI piei. (*Mommsen*, Oskische Studien, 1845–6.)

227. *The nature of the relation* between the German *blei* and English *lead* may be understood from the following table:

Greek	μ	ο	λ	υ	β	δ	ο	ς	
Latin	P	..	L	U	mB	..	U^m		*m* educed from B.
Anglish	b	..	l	o	m	..	a		whence a *bloom* of metal.
Polish	..	o	l	o	v	..	..		
Welsh	p	..	l	w	m	..	..		
Danish	b	..	l	y	..	..	..		and *lod* a plummet.
German	b	..	l	ei	..	..	..		
English	..	..	l	ea	..	d	..		*lode, plumb, plummet.*†

There is a Greek form *μόλβδος*, probably newer, because the V (of the Latin form) is seldom derivable from I, but often from Y.

228. *Absorption* (eisèresis) is the reverse of eduction, and is a kind of elision in which an element is lost when two belonging to the same contact occur together. Thus *l* has been absorbed by *d* in *solder*, and *m* by *p* in the Spanish *copilar* from the Latin original of *compile*.

* "The combinations gu-, khu-, or gw-, khw-, require investigation phonetically. Why should a labial after a guttural be easy? simply because of the ease of preparation, the lips being quite free in the first. But why insert a labial between the guttural and vowel? I think in some cases to keep the guttural from palatisation,—*khwi* running no chance of falling into *kjhi*. In other cases, it may be that the lips leaving the throat free, the vowel is more readily prepared. When the mouth is used to this combination, it takes to it readily. Thus *bhelf* becomes *guelf*, but why does *bhail'ling* become *gibellīn'* and not *guibellīn'*?—You assume the double form to have been the more ancient; but here we have a known case of the double form being more recent; and a case of the single guttural being more recent than the single labial. I think the conclusions of § 224 are therefore hazardous."—*Ellis*, MS. *note*.

† In all such cases as the last two, Mr. J. P. Lesley thinks the analogy maintained by the loss of a labial from between the vowels; he therefore reads b..le..i, le..ad, and considers the full or typical form to have been *μολυβ(α)δος*. Proceed. Am. Phil. Soc., Vol. VII. p. 134. In the Old English of the Legenda Aurea, the metal *lead* stands 'leed,'=LED, and *led* as 'ledde.'

CHAPTER XI.

MUTATION.

La forme des mots varie, leur essence ne varie jamais.—*Baron de Merian.*

§ 229. *Anáthesis or Mutation* is the replacement of one element by another. It is of four kinds:—1, Intermutation; 2, Commutation; 3, Permutation; and 4, Transmutation.

230. *Intermutation* is the interchange of vowels, which may take place in three modes, namely: by

Precession, a moving forwards,
Recession, a moving backwards; and
Transcession, a moving across.

231. *Precession* (>) is a vowel change from a more open to a closer position of the organs, towards the lips or throat. The term is adopted from Crosby's Greek Grammar.

232. *Recession* (marked <) is the reverse of precession, and is much less common. It is the change from one vowel to another on the same side of the vowel scale, as from Latin UrsUs (a bear) to Spanish OsO; Latin dIgitUs, Spanish dEdO; Latin mIrabilis, French mErveille, English mArvel; Latin lIngva, Spanish lEngua, French lA^{n}gue.

233. *Transcession* (marked ≻) is the interchange of lip and throat vowels across the vowel scale, as between U and I in *food, feed;* O, E, in English *snow,* German *schnee* (=ʃnE;) Latin bOnus (good) bEne (well.) It may be combined with precession (≻>) as in passing from O to I, (a rare phase as in *roll, reel; dole, deal;* German *ohr,* English *ear;*) and from E to U; or with recession (≻ <) as in passing from I to O, and from U to E, these three phases being extremely rare.

234. *Anallaxis* is the change from *one* element to *two* others, one of which stands on each side of it. As E stands between A and I (§ 238) it may happen that in the attempt to produce it, the organs may fall successively into the positions on each side of it, producing A-I, or (in case the I is coalesced) Æ, as in the German *mehr schnee* (more snow) which becomes *mai schnai* in low Suabian.* The following are examples from ancient and modern geographical names, assuming that the derived forms have been diphthongal at some period—

ebEllinu^{m} Baillo, bEthsan Baïson, mentEsa Bentaez.

235. *Upon the labial side,* O becomes A-U or AV, as in sonus *sound;* old Suab. lob, German *laub;* Ger. korn, melōne, Austrian *kaurn, melaun;** French bo^{n}té, English *bounty;*

* Wocher, Allgemeine Phonologie, Stuttgart, 1841, p. 244–5.

English bow and *bow*, and in the Irish dialect of English, where bold, hold, cold, &c., become *bowld*, &c., influenced by *l*.

236. *Reversed anallaxis* appears in the Swedish JAG compared with Latin EGO (I,) and in the modern IAlea, from the ancient ELÆA. The following are Rhaetian examples—

TERRA tIAra *earth*, vERMIS vIArm *worm*, vESPA vIAspra *wasp*.

"Some words that might be supposed to be under Wa [English *w*, *a* in *far*,] are to be found under O, as the syllable *wa* is often pronounced like *o*, and *o* like *wa*." (*Baraga*, Otshipwe Dictionary.) The latter (*o*+*wa*, § 245,) is an example of reversed anallaxis, the former (*wa*+*o*) of metallaxis.

237. *Metallaxis* is the replacement of *two* elements by *one* that is intermediate, being the reverse of anallaxis. It occurs in passing from AI to E and from AU to O, as in Latin BALÆNA, Italian balEna (a whale,) Latin CA:VSA, (a cause,) Italian cOsa, French chOse; Latin CA:VDEX and CODEX (a stem.)

238. *The following tables* of the affinities of the primary vowels may be used in studying intermutation. In the second one the complementary vowels are placed; in the third, the close of the organs to French *u* is indicated, and the probable manner in which the letter Y was suggested from its relations to the vowels V (*oo*) and I.

A*rm*

O*we* v*E*i*n*

p*U*l*l* m*ach*I*ne*

A

a*we* u*rn*

O E

U I

A O V Y

E I

239. *Intermutation* being mostly in the closing direction, when U and I are reached, the recession continuing, U may become the labial, and I the guttural coalescent. But let the vowel of the German *kuh* (coo, a cow) be closed to English *w*, and the result (cw in qu-een) is hardly pronounceable until *a vowel is interposed*, when the English form *cow* appears.

240. *If* I *be closed upon* sufficiently to form the guttural coalescent, this must be aided in a similar manner by a vowel, for coalescents appear in no other manner in English. Hence the French *cri*, thus treated becomes *cry*, (that is, in Latin letters CRÆ,) *by precession and epenthesis*, not by anallaxis.

* Castelli, Wörterbuch der Mundart in Oesterreich unter der Enns. Wien, 1847, p. 13.

241. *The coalescent is the principal* element of a diphthong. In Ellenic (Modern Greek) αυ has been closed to αφ and α῾β, consequently it has no coalescent, and consequently it is not a diphthong.

242. *There is a limit to intermutation,* so that it is hardly possible to find an example of a departure from A to O and U, and a return through I and E to A, and a circuit in the opposite direction would be still more difficult.

243. *As* A:V *can return* to O, and A:J to E by metallaxis; and as the former can become U and the latter I by the loss of A; the triplets O, U, AV, and E, I, AJ, furnish two sets of elements which circulate among themselves, apart from the more open vowels. They may be tabulated thus:—

O		E	
AV	U	I	AJ

These relations, and those of Y and German ö are shown in the next diagram.

		A		
	O	ö	E	
AV	U	Y	I	AJ

244. *Anallaxis is older than metallaxis,* and vowels precede diphthongs, so that when both occur in cognate words, those with a vowel may be considered the older, although immediately derived from diphthongs. Thus, although the Spanish *col* and French *chou* (cabbage) are derived from the Latin cāvlĭs (a stalk, cabbage,) and Greek καυλὸς (a stem,) the original vowel was A, as in the Sanscrit ŕălă5 (a stem) the initial of which is less old than the *cay* of the other forms.

245. MARKS OF MUTATION.

+-+ indicates an interchange, as O+-+U, P+-+B.

+- or -+ is placed between a derivation and its primary, the crossed end indicating the root, or earlier form. † indicates a primary, a genuine form, or a true root.

+ indicates a false original, as in +*shine*, +-*shone*, where *shine* is not the true original whence *shone* is derived; one or both having come from an earlier form. The Greek +κλάζω (to make a noise) is not the true original of *clang*, *clank*, because the gutturals of these are older than the palatal ζ. The following are examples of precession.

246. 1. Sanscrit DVA; 2. Danish tO, Irish and Persian do, old English twō; 3. English two (too;) 4 old Nordish tvau; 2′ Belgian twEe; 3′ German zwIe-, Lettish diwi; 4′ German zwei.

4	3	2	1	2′	3′	4′
			DVA			
		to		twee		
	two				zwie	
tvau						zwei

247. 1. Sanscrit dAnta (a tooth;) 2. Anglish tOth; 3. Greek *οδοὺς* Gothic tUnθus, Eng. tooth;—2′. Latin DENS; 3′. Turkish DIſ (deesh;) Eng. tine, in Latin letters TÆN.

4	3	2	1	2′	3′	4′
			dAnta			
		tOθ		DENS		
	tUθ				DIſ.	
—						TÆN

248. *If we pronounce ου* of the Greek form like *ou* in *round,* the word, as far as this part is concerned, will occupy the fourth place of the labial side, and be a newer word than *tooth,* which is newer than *toth,* although the use of *o* in spelling *tooth,* might cause one ignorant of the sound, to suppose the Anglish and English forms to be of equal age.

249. *Precession is commonly confined* to one side of the vowel scale, as in most of the following examples.

A ⊹ O ⊹ U ⊹ AV.

Latin frātĕr (a brother) Gothic brOθar; German brUder; Welsh brawd.

Latin sānus (sane =SEN;) Belg. zOnd; Angl., Dan. sUnd; Eng. sound, with *d* educed from *n.* Latin pălūs; Isl. POL, Ang. PUL a *pool.*

Lat., Sp., Ital., cŏrO˘nă, Belg. krOon; Rhaetian, crUnna; Eng. cr*ow*n.

250. A ⊹ O ⊹ U ⊹ I

Here U, instead of becoming AV, crosses to I. Latin fA˘gus; Angl. bOc; Ger. bUche; Eng. b*ee*ch. The Rhaetian *fau* is from FAGUs by elision.

Latin illO˘c, illUc, illIc (thither.)

251. A ⊹ E ⊹ I ⊹ Æ.

Latin ălA˘cĕr; Fr. lE′ger; Sp. lIgero; Eng. light (active.)

Ang. nAther; Old Eng. nEther; Eng. neIther; and (vulgarly, as if) nigh-ther.

Isl. badi (both,) old high German bethe; old Fris. bide; German beide.

252. *A regular transition* has occurred in English from A thorough E to I, and the secondary vowel of *it.* This is shown by the fact, that the character 'A, a, *a,*' used throughout the world with its proper power in *arm, far,* has in English acquired the power and name of the European 'E,' this in its turn has been confounded with the European 'I,' which, by a similar perversion, has become the partial representative of an epenthetic A.

253. *The following are examples* of Latin words passing through French to English:—

pāx	paix	peace	răcēmŭs	raisi^{n}	raIsin
ăqvĭlă	aigle	eagle	† rătĭōn-ĭs	raiso^{n}	reason
trāctārĕ	traiter	treat	dŏmĭnārĕ	domine*r*	domineer
sătĭo	saiso^{n}	season	fāctū^{m}	fai*t*	feat
măcĕr	maigre	meagre	clārūs	clair, ‡clér	clear
ācĕr	aigre	eagre	bālātū^{m}	O. Ger. blēat	bleat.

Old Ger. slafan, Goth. slēpan, Eng. sleep, =SLIP. Ger. bārt, Ang. bērd, Eng. beard, =BIRD. Latin GRAVIS, Rhaetian grēv, Eng. grave, grIeve. O. French spare, Ang. spēre, O. Fris. spiri, Eng. spear. Ger. bahre, Fr. bière, Eng. bier, =BIR. Latin CLAVIS, Fr. cle*f* =CLE, Persian kelid, Hung. kults, Eng. key, =CI. Sp. vinagre, Fr. vinaigre, Eng. vinegar. Latin strātă vĭă, Old Eng. street, =STRET, Eng. street, =STRIT.

254. *The apologists of English spelling* will observe, that these English words with I, derived from an original A through an *ai* or *e* spelling, follow neither, but represent the derived I sound in the six modes *ai, ea, ee, e-e, ie, ey*:—raIsin* alone taking the form of *plait* = PLIT. This literary irregularity does not appear in Latin, where precession is equally present, as in jăcĭo I throw; ējēcto and ējĭcĭo I cast out:—căpĭo I take; āccēpto I accept; āccĭpĭo I receive, whence *keep*, =CIP.

255. *The name of the English* people, language and country, affords a good example of this change. The country was ānglĭă, the adjective and personal noun of which was ANGLICUS, whence the Anglosaxon language will be called English. The A of this became ɛ in *met* in the Germanic dialects and old *E*nglish, and the vowel of *it* in proper *I*nglish, Ital. Inglese, &c. And as *I*nglish is almost as old as *E*nglish, we find these words spelt with I in some of the earliest records of the language. Thus Craik (Sketches of Literature, 1844; 1, 208) quotes the date 1113 for

"Ingland is thyne and myne."

Yet to this day,† this venerable *I*nglish language is ignored out of deference to *E*nglish, (from which many of its forms *are not derived*,) and to the dialects of Scotland, Ireland, Yorkshire and Holland.

256. *In passing from Latin to Italian* and Spanish, E is usually retained, although it may become I, as in—

* Walker's pronunciation—but now pronounced in the Irish mode. The etymologic spelling (so important with litterateurs,) being *raiz*-, both in *raizin* and *reason*, the Irish mode was as proper for the latter as the former—for English speech and writing do not follow the same laws.

† February 5th, 1858.

ăllĕvārĕ	Spanish	allIviar	*to alleviate*
crĕātūră	"	crIatura	*creature*
dĕus	"	dIos	*deity*
ēcclēsĭă	"	Iglesia, Fr. églIse	*church*
æqvālĭs	"	Igual, Old Fr. Igale	*equal*
rēspōndĕrĕ	Ital.	rI˘spóndĕrĕ	*to respond*
sēcūrus	"	sIcuro	*secure.*

257. *A vowel may be preserved for ages* unchanged. The following are examples of vowel identity between Latin and English.

ŏbēdĭo	*obey*	rēgno	*I reign*	vēnă	*vein*
rĕdĭmo	*redeem*	prĕcor	*I pray*	vēlo	*I veil*
sĭtus	*seat*	mărīnus	*marine*	vērbēnă	*vervain*
crōc-ĭo	*croak*	ārmă	*arms*	pūppĭs	*poop.*

Here the etymologic E is represented by *ey, ei, ay, ai;* etymologic I by *ee, ea, i-e,* (§ 254,) and etymologic O, U, by *oa, oo.* Thus, an orthography which represents *different* forms as similar, must represent *identic* forms as different, and must still be considered etymologic.

258. *The following words exhibit an identity* of vowels between old Frisian and English.

fri	*free*	hi	*he*	swet	*sweat*
hir	*here*	mi	*me*	wepn	*weapon*
iven	*even*	thi	*thee*	hwer	*where*
del	*dale*	breker	*breaker*	tema	*tame*
hel	*hale*	stil	*steel*	niar	*near*
spiri	*spear*	tron	*throne*	saterdi	*saturday.*

Here a genuine I is represented by *e, ee, e-e, ea.* Here *me* is torn from its affinities Latin MIhi, Italian MI, German MIr, to associate it with Anglish *me,* or perhaps French *me,* which is neither ME nor MI.

259. *The vowel relations* of allied languages are often irregular, as in the following Flemish and English examples, which have the same vowel (*o* in floor, door,) in the Flemish, but different ones in English.

voor	*fore*	sermoon	*sermon*	voor	*for*	doof	*deaf*
loos	*loose*	soon	*sun*	oor	*ear*	droom	*dream*
boom	*boom*	zoon	*son*	rood	*red*	stroo	*straw.*

260. A:J *and* A:V *have arisen* in the English *hide* (a skin) and German *haut,* from the old high Ger. HUT, which took the German form at one step, whilst the English form

had to pass through the Anglish *hyd, hid.* *Hide* is newer than *haut,* but not derived from it, as represented in dictionaries; nor is *bound* derived from *bind.*

261. A:V *becomes* awe *in English,* by metallaxis (§ 237) varied by recession from the O point. *Chaw* has therefore not arisen from *chew,* but from a form like the German *kauen.* The Saxon (Lower Saxon) *kluven* precedes the Anglish *clavian* (*clawian*) and this the English *to claw.*

262. A:V *cannot occur before labials* in English, as it can in German. Hence, old high German bōm (tree, pole,) became *baum* in German by anallaxis, and *boom, beam,* in English. German forms like the following are unknown in English, nor are they the antecedents of the English equivalents, although often quoted as such.

haufe *heap*	saum *seam*	laub (*leaf*)	haupt *head*
laufen *leap*	saufen *sup*	auf *up*	raum *room.*

263. A:V *cannot occur before gutturals* in English; hence, there never were such English words as *bough, plough,* with a guttural following a diphthong, for the moment the diphthong appeared, the guttural disappeared. If the guttural was transmuted into *f,* as in *rough,* there could still be no diphthong before a labial. Richardson quotes Robert of Gloucester's *plowstaf* as his earliest citation for '*plough;*' and for *bough,* a line of Piers Ploughman (1362.)

Theer som *bowes* bereth leves, and some bereth none.

In the same work *doute* is used; Robert of Brunne (1330) has *douted;* and Robert of Gloucester used *doutless* about the year 1297.* From these and the French *doute,* the modern *doubt* is strictly derived, diphthongs being newer than vowels, and as the diphthong *could not be formed* without first rejecting the *b,* the subsequent representation of this rejected consonant was a mere literary blunder.

COMMUTATION.

264. *Commutation is a grammatic* interchange of elements, as in the C^k^eltic languages. Thus, in the Gaelic, in writing mōr (great) and bēn (mountain) to indicate a *great mountain,* the *b* becomes English *v,* giving (in English spelling) *more-vane* instead of *more-bane.* In Irish, *mo* (my) and *mac* (son,) the *a* as in *what,* become, when used together, mŏ ṁac, the dotted *m* being English *v.* Welsh eu Brawd (their brother,) dy Frawd (thy brother,) fy Mrawd (my brother.) Here, as in Chinese, the affinity between nasal and pure (*m, b,*) is acknowledged and used in language.

* Shakespeare alludes to a dialect or pedantism in which *doobt* for *doute* was used, and from which the *b* was disappearing. See Love's Labor Lost, Act 5, Sc. 1, 1631—"He draweth out the thred of his verboſitie, finer than the ſtaple of his argument. I abhor ſuch phanaticall phantaſims. . . ſuch rackers of ortagraphie, as to ſpeake dout fine, when he ſhould ſay doubt; det, when he ſhould pronounce debt; d e b t, not det; he clepeth a calf, cauſe; halfe, haufe: neighbour *vocatur* nebour; neigh abreviated ne:"

265. *Maraud;* Welsh mōr (the sea,) morawd (a seafaring,) ei Forawd (his seafaring,) which suggests *Foray*, and the Irish foraim a journey; Old French *forer* to *forage*.

PERMUTATION.

266. *Permutation is the interchange* of consonants of the same contact, and the well-known *Grimm's Law*, is a permutation analagous to the law of the vowels already stated.

267. B, P, F, M, &c. Latin FĭBĕr, Polish *bob*r, Eng. *b*eav*e*r, Sw. *bef*w*e*r—ske*w*er, ski*v*er, —lie*u*, le*f*tenant, lief,—glădĭUs, glave,—āBsentia, Sp. a*u*sencia,—Angl. oredh, Eng. breath, —Hungarian kra*b*sálni, kra*p*sálni, kra*m*sálni, to s-cribble,—Greek *Μετὰ* and *Πεδὰ*, German *m*it, Eng. *w*ith,—Latin cŭMŭlŭs, Dan. ho*b*, Ger. hau*f*e, Eng. hea*p*,—Polish *b*ar*w*a, German *f*ar*b*e, color.

268. D, T, Th, L, N. Swedish, lite*n* and lite*t*, Eng. litt*l*e,—Dan. te*l*t, Eng. te*n*t, Lat. ăNĭmă, Sp. a*l*ma,—Rhaetian fau*l*sch, and fo*d*sch, a falchion,—Lat. ŏDŏr, Sp. o*l*or,—Lat. pērDīx, Ital. per*n*ic$_2$e, a par*t*ridge,—Hungarian le*g*y (with a *d*) and le*n*y, being,—Ger. *d*ing, Sw. *t*ing, Eng. *th*ing,—Eng. *th*orn, Ger. *d*ōrn, Sw. Dan. *t*orn. The American tribes of Me*n*ómonies and Assini*b*oi*n*s, were formerly known as Ma*l*ominis and Assini*p*oi*l*s.

269. R, S, &c. Requi*r*e, requi*s*ition,—hu*r*rah, hu*z*za,—rai*s*e, rea*r*,—jee*r*, je*s*t,—thi*s*, the*s*e, —Ger. frie*r*en, to free*z*e,—Latin Rōbŭr, a kind of oak, Sūbĕr, the cork oak. In French and English, *s* between two vowels usually becomes sonant, as in mi*s*ery, depo*s*it, bu*s*y, the sonancy of the vowels being communicated to it.

270. *As Latin was without the sound* of sonant *s*, the tendency to form it between two vowels had to take another course. In poetic Latin the word for tree was ARBOS, which in the regular genitive case would make *arbosis*, but ārbŏrĭs was preferred, and the constant presence of *r* in the oblique cases *induced* (§ 214) its presence in the nominative ārbŏr. Latin ÆS (brass, pronounced *ice*) ÆRIS, Gothic *ais*, *aizis*, with French *ai* and *z*. Latin spē*s* (hope, pronounced *space*, but long,) spē*r*ārĕ (to hope.) Nearly parallel with these, are the permutations of the true palatals.

271. G, C, J, Ng. As G and J have the same co-relation as B and V, they are equally permutable, as in re*g*al, ro*y*al,—*g*arden, *y*ard,—Sp. pa*g*ar, Fr. pa*y*er, to pay,—Gr. *χαίνω*, Ang. *g*eonan, Eng. *y*awn,—Old Frisian *i*est and *g*ast a *g*host. In vulgar English *y* is educed from *cay*, *gay*, as in kind, cow, card, pronounced CJÆND, CJA'V, CJARD.

272. *The Greek χ loses its aspiration* in English, as in *χάος* chaos,—*λείχω*, Gothic lai*g*o, to lick,—*χολή* *g*all,—*χρῖσμα* (chrism, and) *g*rease. Spanish *j* (*g*) and Latin J, C, G, are permutable in Sp. eno*j*ar (to weary,) Fr. ennu*y*er; Sp. o*j*ear, to eye, o*g*le, from ŏCulus; lĕGĭbĭlĭs, Sp. le*g*ible. The Latin 'J' has acquired this power in Spanish, nearly corresponding to the conversion of 'V' to an 'F' power, as in German, where *v* is *f*.

CHAPTER XII.

TRANSMUTATION.

IN NOVA FERT ANIMUS MUTATAS DICERE FORMAS CORPORA.—*Ovid.*

§ 273. *Transmutation is the interchange* of consonants of different contacts. It is due to Otosis, Assimilation, Dissimilation, Glottosis, Metallaxis, and Anallaxis. Its importance entitles it to a distinct chapter.

274. *The peculiarity of Latin,* Welsh, and English, which place together a guttural and a labial (§ 222—4) of which one alone can be used and permuted in some other languages, may give rise to many apparent transmutations, as in the Welsh pedwar (four) and Irish căthăr (already cited,) which seem to present a transmutation between P and Cay.

275. *Welsh has few words commencing* with English *w,* but so many with *gay* preceding it, that this guttural is prefixed by induction to introduced words which were without it. This language has *winc, pinc,* and *gwinc* (a finch,) and the following examples show how new words might arise like the French G(u)illaume and English William with a seeming labial and guttural transmutation.

gward, *a guard, ward*	gwin, *wine*
gwyrd, *verd-ant*	gwinegar, *vinegar*
gwyn (white,) *wan*	gwing, *a wince, a wink*
gwae, *woe,* Sp. guay, Lat. VAE!	gwag, *a vac-uum*
gwallo, Lat. vāllo, *to wall*	gwr, gwyr, Lat. vĭr, *a man*
gwlan, Lat. vēllus, *wool*	gwarant, *guarantee, warrant.*

276. *As the labial vowel* U and guttural I are interchangeable, and have an intermediate in Greek Y, this has had a tendency to induce an occasional interchange between labials and gutturals.* This *partially* accounts for the forms *Βάλανος* (acorn) Latin Glāns:—*λύΚος* (wolf) Latin luPus. In *λύκος* the guttural is preceded by a partially guttural vowel, and in the Latin form, P is preceded by the labial U.

277. *In the Belgian bevrijd* and gevrijd (be-freed) there is no transmutation, because be- and ge- are distinct prefixes, probably present in *Βλέφαρον* and *Γλέφαρον* (eyelid) from *βλέπειν* (to look,) which may be connected with *λάμπειν* (to shine) and g-leam. Compare the German Flimmern, and English Glimmer. The stem of *Β-ράχ-ω* and *Κ-ρέκ-α* (to ring, c-rack) is seen in *σύ-ριγ-μα* (a c-reaking.) *Πότερος* (which of the two,) Aeolic *Κότερος*, seem to have a different prefix, to a stem seen in the Latin utĕr, with the same meaning.

* Olivier, Des Sons de la Parole. Paris, 1844.

278. *The Greek* σκύλον is considered the original of the Latin spŏlĭūm (booty;) but σκύλον may be a cognate of cŭtĭs (a skin,) καλύπτω (to hide,) cēlo (to con-ceal;) and S-POL-IU^{m} may be a cognate of pēllĭs (a skin.)

OTOSIS.

279. *Otòsis is a change in words* due to a misconception of the true sound, influencing consonants of the same quality; nasals, aspirates, sonants, and surds, generally retaining these phases in their new position. The word is formed from ὦτος, the genitive case of οὖς (the ear.)

280. *The French nasal vowels recall* the sounds which most nearly resemble them in English, as *m, n, ng*. This has turned -o^{n} into -oon, as in pontoon, bassoon, dragoon. —M++N. Eng. boso*m*, Ger. buse*n*, Latin Mēspĭlu^{m} (a medlar,) Ital. *n*ĕspŏlă.

281. H++S. Gr. ἕλικῆ, Latin Sălīx, willow,—ὑπέρ, Supĕr, over. In Hebrew, H occurs final, but becomes S in Greek and Latin, partly by induction and partly by otòsis. Hence, the double forms Jona*h* and Jona*s*; Jeremia*h* and Jeremia*s* (with English *y* as initial,) perhaps inductively aided by Greek names in -as. There is a final Sanscrit aspirate which has a particular character, neither *h* nor *s*. *This was probably h* pronounced with the mouth partially closed, causing the breath to strike the palate and teeth, thus giving an effect resembling *s*. As heard by us in modern Bengalee, it sounded like a short abrupt *h*. We have proposed the figure 5 for it, as this is sufficiently like *s*, whilst it resembles one of the forms of German capital *h*.—H++F. Archaic Latin Fircus, Lat. Hīrcus (a goat.)

282. Sh++S, H. A person unacquainted with the English sibilant *sh*, would be likely to refer it to *s* or *h*, or to some other surd aspirate he might be familiar with. Hence, the English word *sheep* has become HIPA in Hauaian, and SIP in Penobscot. For a similar reason the peculiar 'cerebral' *s* of the Sanscrit word for *six* became *h* in the Greek ἕξ, and *s* in the Latin SEX; whilst the Sanscrit word (said to contain English *sh*, and *w*) sh w a sh u r a became (if indeed this is the oldest form,) Greek ἑκυρός (brother-in-law) and Latin sŏcĕr. Having the original element *sh*, the Germans preserved it in their form sch w a g e r, and the Hungarians (*s* as *sh*) in s o g o r. The Latin took *s* by induction in both cases, because as an initial, *s* occurs about twenty times as often as *h*. The *cay* of the Latin SOCER is probably older than the palatal of the oriental form, which may have been sh w a c u r a originally.

283. Ch++F. *When the old English ch* (χ) began to fall into disuse, its sound was either dropped, as in tho*ugh*, thro*ugh*, plow, not, or confounded with *f*, as in tough, cough, rough, enough. So χολή, which by permutation gave Gall and Colic to English, gave Fĕl (gall) to Latin. Contrariwise, the English craft, soft, after, are the Belgian kracht, zacht, achter.

284. Th++Ch, Ph, S. Gr. *ὄρνιΣ*, gen. *ορνιθος* (a bird,) Doric *ὄρνιξ*, gen. *ορνιΧος*,—*Φλάω* and *θλάω*, to bruise,—Doric *αΣάνα* for *αθάνα*, Minerva,—*Σιὸς* for *θεὸς* a god, Eng. Theodore, Russ. Fedor. D++G, B. Doric *Δᾶ* for *Γᾶ*, the earth; but *δνόφος* (darkness) for *γνόφος* is by assimilation. Aeolic *Βελφὶν* for *Δελφὶν* a dolphin,—*σάΜΒαλον* for *σάΝΔαλον* a sandal,—Ital. coDardo (a coward,) Sp. coBardo, partly influenced by *o*.

285. G++B,—C++P. *Γλήχων* Attic *Βλήχων* pennyroyal,—*Πύανος* and *Κύανος* a bean.

286. T++P, C. Aeolic *σΠάδιον* for *σΤάδιον* a race course,—Latin VĕTulus (old,) Italian véCchio. Although T is more easily formed than Cay, if the number of the latter greatly predominates over the former, the rare occurrence of Cay derived from T may be the result. In a paragraph of Hauaian containing 160 consonants, 28 per cent. were *cay*, whilst a Latin paragraph furnished about 9 per cent. The former example contained no T, so that any word coming in with this sound would be likely to fall into *cay* by induction.

ASSIMILATION.

287. *Assimilation is the change of a consonant* to adapt it to another with which it is brought in contact. The *n* of *in* becomes *m* before *p, b, m*, by assimilation, as in im-plore, im-bue, im-mense, but remains unaltered before *f, v, w*, as in in-fect, in-vert, in-wall. *a. Latin* n *always became* ng *before gay, cay, ch, q*, as in īn^{g}cērtus, īn^{g}gĕnuus, ān^{g}chīsēs, īn^{g}qvīro, (§ 101) these words being cited for it by the ancients.

288. *Latin had a peculiarity* still preserved in Italian, of doubling a consonant as *tt* in āttēndo, and *nn* in ānnūncĭo. One of these consonants is in most cases absorbed in English, as in *attend, announce,* in writing which, the second character is a mark of shortness for the preceding vowel. There is but one *f* in a f f i n i t y, Fr. a f f i n i t é, Sp. a f i n d a d, but the Spanish alone shows its etymologic relation to the Latin āffīnĭtās (gen. affinitat-is) and Italian a f f i n i t à, because there is no dissimulation about it, no misrepresentation, it pretends to nothing but what it is entitled to, and claims no addition but that of vocality for the *t*.

289. *If 'accept' were a Latin word*, it would be written *axept;* but its prefix *ad*, (which became *ac* before *cay* in āc^{k}cēpto,) became *s* before an *s* sound, as in ās-sŏcĭārĕ (to associate,) so that *assept* would have been the Latin form of the English word, and in fact, the true English form, because *ad-* stands in inscriptions unassimilated, as in ADCENSUS, ADFECTUS, and as the assimilation was a departure from the true form which could not be transplanted into English, the attempt should not have been made.

DISSIMILATION.

290. *Dissimilation is the reverse* of assimilation. It prevents unusual combinations, and is due to induction. MF are incompatible sequents in Italian and Spanish, where they

break the law of assimilation and transmute (§ 273) *m* to *n*, turning NYMPHA, SYMPHONIA, into *ninfa, sinfonia.*

291. *In Italian* (as in Latin) *mm* are compatibles, as in *commissione, commissario;* whilst in Spanish, one *m* is dropped from *comisi-on, comisario,* as in the English equivalents *commission, commissary.* When one *m* is not absorbed in Spanish, the *n* is unassimilated, as in *conmoci-on conmiseracion, conmemorar.* Dissimilation occurred in Latin, for although *mf* occurs in the original of *circumflex,* we find *an-* for *am-* (ambi) in ANFRACTUS (a turn;) and the inscriptive forms CIRCVNFLEXVS, CIRCVNVENIO, CIRCVNDATA.

292. *The Greeks spontaneously rejected* two aspirates in certain cases; hence *Θ* in *Θρὶξ* (hair) became *T* in the genitive case *Τριχὸς* in consequence of the presence of *χ*. So *Τρέχω* (I run) is *Θρέξω* in the future tense; and *Τρέφω* (I nurse) is *Θρέφω*. The -ish in the words Engl-ish, Span-ish, seems proper in Belg-ish, with *gay;* but if corrupt *dzh* is used, this *Belgish* will give way to *Belgian* or *Belgic;* whilst *Russish* is rejected for *Russian.*

293. *The English ordinal suffix* -th in four-th, nin-th, is -d in thir-d, and -t in fif-t, six-t, in the speech of those in whom the language instinct has not been effaced. In old English we find first, second, third, fourth, fift, sixt, seventh, eight, ninthe, tenth,—*eight* being due to the aspirate once present in this word, which with its loss, could take *th* in *eighth.*

GLOTTOSIS.

294. *Glottòsis* is an organic change* to facilitate ease in utterance, and it depends greatly upon the number, order, and frequency of occurrence, of the consonants concerned in it; practice making that easy in one language, which is difficult for those who speak another.

295. *As the base of the tongue* has less room and is less flexible than the end, it is more difficult to adapt it to the production of its peculiar consonants, so that children replace them with dentals and palatals, saying *do* for *go,* and *til* for *kill.*

296. *The cavity of the mouth being set* for the following vowel whilst the consonant is about to be formed (§ 203,) the closer aperture required by the vowels of *key, get, gay,* afford so little room for the action required to produce their consonants, that there is a tendency to use the outer portion of the tongue, which is thinner and more flexible, and has more room in the outer mouth. This action, which is often united with cyclesis (§ 207,) converts gutturals to dentals and palatals, particularly before I and E. In some cases, where orthography is not properly understood, this has perverted characters made for guttural sounds, to enervated powers (usually called *soft,*) in various modern languages.

* Glottòsis, as a word, is formed from *γλῶττα,* the tongue, by analogy with certain names of diseases, (amauròsis, pyròsis, phlegòsis,)—this being frequently as great a defect in speech as stuttering, which is classed with diseases. As the word *language* is applied to speech in general, because the tongue (lĭngvă) is its chief implement, so *glottosis* is proposed for *organic* transmutation between all the contacts.

297. *Compare* Gree*k* Greece; arc arc*h;* bar*k* bar*g*e; Latin LEGIBILIS, Fr. lisible, Eng. le*g*ible. The English *tsh* is commonly replaced by *ts* in German and *sh* in French, as in Lat. Cămĕră, Eng. *ch*amber, Ger. *z*immer, Fr. *ch*ambre.*

298. *This change is widely spread,* for although the speech of different countries may vary greatly, its expression is due to the same organs. Volney remarked it as a dialectic peculiarity of Arabic; and Morrison informs those who wish to use his Chinese Dictionary, that words like (*ch* in *chip*,) chăng vary to tsang; and that *k* in the Peking dialect, "before *e* and *i* is pronounced as *ch* and *ts;* thus *king* is turned into *ching*, and *keang* becomes *tsëang*." Morrison does not state whether *k* becomes *tsh* before *i*, and *ts* before *e*, with any degree of uniformity, as in Russian, where, in certain inflexions, *k* becomes *ts* before *i*, and *tsh* before *e*.†

299. L ++ R. These two consonants are made so near the same point that they are readily transmutable, and to such an extent in Hauaian, that they are used indifferently. R is wanting in some languages, and L in others.

L++R.				S++T, D.			
Sp.	milagro		*miracle*	Ger.	hăss		*hate*
"	papel		*paper*	"	aus		*out*
"	peligro		*peril*	"	weiss		*white*
"	sabel		*sabre*	Dan.	ædike	Ger.	essig, (vinegar)
"	esclavo	Port.	*escravo*	Ger.	hat,	Dan.	har, *has*
"	eneldo	"	*endro* (dill.)	Gr.	ῥόδον	Lat.	rŏsă *rose.*

300. Interchange of th, sh, zh, r, l, n, d, t, s, between ancient and modern geographical names.

ALAMATHA	Elamora	BERGUSIA	Balaguer
PONTES	Ponches Fr.	LACARIA	Lancona
ARAVSIO	Orange	ORONTES	Eluend
CHARADRUS	Calandro	METELIS	Missil
CALIFFAE	Carifé	PALURA	Balasor.

301. *In consequence of the projecting jaws* and teeth (prognathism, *g* pronounced,) of the

* Mr. Ellis writes several notes, the purport of which is, that "*tsh* descends from *k* viâ *kj* historically, and *dzh* from *g* viâ *gj*, as also *tsh dzh* descend from *tj*, *dj*, as in *nature*, *verdure*. . . . I think we can as well believe *kj* to have become *tsh* in Sanscrit as in Italian. . . . Wallis (1653) analyses *sh*, *zh*, *tsh*, *dzh*, into *s-j*, *z-j*, *t-j*, *d-j*, and Smith (1568) shows that the former are nearly related to the latter in sound. . . . Salesbury (1547) gives *si* as the nearest Welsh for *sh*, resembling it, says he, as copper does gold."

† Grimm's Geschichte der Deutschen Sprache, §382.

African race, it is not easy to place the tongue in the proper position for making *th*, even when English is their vernacular, so that it is often replaced with *f*, as in *south*, *nothing*, &c. This renders *th* doubtful as an African element. Shakespeare's 'Moor' being a negro, his name, to have a rational form, must be *Otello*, as the Italians make it.

302. *There are four or five times as many* Italian words in pia-, fia-, chia- (*ch* as *k*,) as in pla-, fla-, cla-, showing a preference for the former. This partiality caused the elision of *l* and the insertion by induction of I or J, rather than the transmutation of *l*. This from Latin produced the Italian forms—

FLAMMA	fiámma	*flame*	PLUMA	piuma	*plume*
CLARUS	chiàro	*clear*	PLANUS	piāno	*plain*
PLANTA	piánta	*plant*	PLUVIA	pioggia	*rain.*

303. *In the last example* the corrupt *g* (in *gem*) is made from English *y* in PLUVJA, the V being lost, and the second 'i' inserted to aid in spelling the corrupt *g*. The loss of V and the change of I to J (as in passing from fil-i-al to fil-ial) is the only difference between the ancient geographical name SALVIA, and the Italian form *Saglia*=SA-LJA. This irregular Italian orthography disguises the close relation between the ancient and modern geographic names—

PAL-A-NI-A	Ba-lā-gna	SE-NI-A	Sē-gna
OL-LI-US	ŏ-glio	TER-BU-NI-O ×	Trĕ-bi-gna
PAL-LI-A	Pă-glia	CO-LO-NI-A	Co-logne, Fr.
AL-BI-NI-A	āl-bē-gna	HIS-PA-NI-A	Es-pagne "
HOS-TI-LI-A	ŏs-tī-glia	BRI-TAN-NI-A	Bretagne "

304. *That elision of* L *and epenthesis* of I or J are concerned in FLAMMA, fiămmă, is proved by the Spanish forms, where both L and J (written *ll*) are heard, as in llama (flame)=LJAMA, or in the English *collier* for *coaler*.

Latin,		*Italian,*	*Spanish.*
PLANUS	*plain*	piano	llano
PLENUS	*full*	piēno	lleno (& cheno)
CLAVUS	*key*	chiave	llave
†PLANTAGINIS	*plantain*	piantaggine	llanten.

305. *By taking Portuguese* into account, we find a newer form in which PL-, &c., are lost, and the J converted into French *ch* (Eng. *sh*, or dialectically into *tsh*,) by glottosis—

Latin,	*Italian,*	*Spanish,*	*Portuguese.*
CLAMARE *to cry*	chiămāre	llamar	chamar
PLUMBU^{m} *lead*	piŏmbo	plomo	chumbo
PLORARE *to lament*	. . . . .	llorar	chorar
PLAGA *a blow*	piāga	llaga	chaga
PLUVIA *rain*	piŏvĕre	llover	chover.

306. *A union of three vowels,* as *aie,* or *eia,* is contrary to the genius of English and its antecedents, and when, by the elision of a consonant, three vowels are thus brought together, and the intermediate one is I or E, it first becomes J, and then perhaps a palatal, as English or French *j*. It is not, as we are commonly taught, the B of the Latin răbĭēs that becomes *zh* in the French *rage,* and *dzh* in the English *rage,* but the I. *This is confirmed* by the Rhaetian form *rabgia,* in which *i* indicates corrupt *dzh.* The supposable intermediate steps between Latin and French (the first and fourth column) are given here in Latin Letters, but *abbreviare* is not a classic word.

ābbrĕvĭarĕ	ABRE..IAR	ABREJAR	a..brége^{r}	> *abridge*
DILUVIUM^{m}	DILU..IU	DILUJE	< déluge	*deluge*
RABIES	RA..IES	RAJE	rage	> *rage*
SALVIA	SA.. ..IA	SAJE	> sauge	≍ *sage*
CAVEA	CA..EA	CAJE	cage	< *cage*
SEPIA	SE..IA	SEJE	sèche	*cuttle-fish*
RUBEUS	RU..EUS	RUJE	rouge	*ruddy*
Sp. gubia	GU..IA	GUJE	gouge	> *gouge.*

If the elided B of răbĭēs had been D, *rage* &c. would have been examples of partial metallaxis (§ 312, 313,) the D tending to draw the J into the palatal contact.

307. As *sa..ia* made French *sauge* (the plant *sage*) with a *sonant* 'g' due to the sonant *lv* of the original; and se..ia made *sèche* with surd 'ch' due to surd *p* of the original, we may account for sonant *zh* in fusion, and the surd *sh* in mission.

308. *Although mission, nation,* with *sh,* are derived from the French miss-i-o^{n}, na-ti-o^{n}, (NASIO^{n}) with *s;* and *fusion,* with *zh,* from fusio^{n} with *z,* there is no transmutation of *s, t, z,* to the English palatals, the French consonants being lost, whilst *their influence remained.*

309. *Those go upon a false assumption* who think they are justified in using *c* as an alphabetic character for *sh* from the analogy of *ocean.* It is the *e* which is the real *sh* here; and the *t* in *notion* has as little to do with the same sound, as the *p* of *sepia* in sèche, or in the Old French *pipion,* which, as an English word, is pronounced *pigeon,** as the Italian *storion-e* is pronounced *sturgeon* in English.

* See Paradoxes 1 and 6, § 41 *a.*

310. *The word 'oceanic'* (with *s*) *is older* than 'ocean' (in two syllables,) and is not derived from it; and when both are pronounced with *sh*, this sound is represented by 'e' in 'ocean' and by 'ce' in 'oceanic,' where 'e' does double duty as a consonant and a vowel. The word is more correct when pronounced o-se-an-ic; so is pro-nun-si-a-tion, because making *sh* out of *si*, elides the *vowel* power of '*i*' and reduces the word one syllable.

311. *If, by the conversion of i* into English *y* or *zh*, o-be-di-ent becomes o-be-dyent (the writer's mode of speaking,) or o-be-dzhent, no speaker of real English can preserve *both dzh* and *i;* yet Walker has coined a jargon with such forms as o-be-je-ent, and cris-tshe-án-e-te. Similarly, if 'omniscient' has an *s*, it has four syllables, if *sh*, it has but three. Compare the dissyllables Russia, Asia, conscience, and the trissyllables militia, malicious.

METALLAXIS (§ 273) OF CONSONANTS.

312. *Sh being made posterior* to the *s* position, and anterior to that of *cay*, it may happen, that in the attempt to pronounce the combinations *s-ch* (σ-χ,) *sk*, *sy*, *ty*, the tongue, instead of taking both elements in rapid succession, may fall between them upon *sh*. In this manner English *sh* has arisen from Anglish *sc* (Swed. Dan. *sk*) and Belgian *s-ch*, as in ship, shaft, shape, shovel, shed, fish, &c. Latin Mūscă, (a fly) Fr. mouche; maStĭCārĕ (to chew) Fr. macher.

313. *English u being yoo, su* (when not the *soo* of uncorrupt speakers,) either drops the *y*, or falls into *shoo*, &c., as in sugar, sure, treasure, pleasure, where it is not the *s* so much as the *y* of *u* (yoo) that has the power of *sh*. It is the *s* which may be said to draw up the guttural through *sy* to the *sh* position. When *sh*, *zh*, *tsh*, *dzh*, occur before a vowel written with 'u,' this may not be read *yoo*, as in sure, azure, chuse, jury. The forms 'ishyoo' for *issue* (íshoo, in legitimate, as compared with pedantic English,) and 'mezhyoor' for *measure* (mézhr,) seem to have been manufactured from the old spellings, under the impression that *ss* in *issue* represent *sh*. In 'ishyoo,'* 'u' is a triplet, composed partly of *sh*, and entirely of *y-oo*. If the 'u' of *unit* occurs in *sue*, *suit*, these words must become *shoe*, *shoot;* but if the *s* is preserved pure, the vowel must be that in *boot*. There is no other alternative. Whatever mistakes foreigners may fall into, or elocutionists manufacture, this is the law—the genius—the philosophy of English speech.

ANALLAXIS OF CONSONANTS.

314. *As the Greeks could not pronounce* the oriental *sh*, they either transmuted it into *s*, or (by anallaxis) used their ξ *ks* for it, as in *Artaxerxes*, in (modern) Persian *ardeshir-shah* (great king, or lion.) French 'charnière' (a hinge,) Belgian scharnier, with σ-χ from *sh*.

* This is often said in England, according to Mr. Ellis' MS., "to avoid the pedantic effect of *is-yoo* on the one hand, and *ish-oo* on the other, which is thought flat, broad, vulgar, inelegant, and comparable to *noo* (Franklin's pronunciation) for *nyoo*. . . . I grant you that either *ish-oo* or *is-oo* would be in accordance with the genius of our pronunciation; but fashion dislikes *soo*, *soot*, for *sue*, *suit*, and laughs at *shoo*, *shoot*, as Irishisms."

CHAPTER XIII.

ETYMOLOGIC BEARINGS.

We must not permit ourselves to be guided solely by the eye nor by the grammarian either; but must, on the contrary, consult the ear.—*Bonnycastle*, Classical Museum, No. 23, p. 32.

§ 315. *Mr. Ellis has calculated* (Plea, 2d ed., § 36,) that not more than one person in 1600 can be benefited by an etymologic orthography, and it has been asserted that all the countries of which English is the language, do not furnish five hundred etymologists. There are, in fact, more good mathematicians and good chemists than good etymologists, and whilst few chemists would be at a loss to give the rationale of their processes, the authors (Sullivan, Graham, Lynd,) of popular school etymologies, cannot explain *their own examples*, nor distinguish between *mutation*, *elision*, and *insertion*.

316. *The chemist works primarily with things*, and secondarily, with symbols; the scholar does the reverse, studying symbols rather than living speech, as a deaf mute would be compelled to do. Hence Schele de Vere* calls the French word for water "*eau* (*o*)" a triphthong; he says most English radical words have been reduced to monosyllables "at least in pronunciation;" and that "the changes of sounds and their growth go on continually, and thus the *spelling* of a language gives us the only true account of its *first* form and *subsequent* historic changes. This is the *principal* and *all-powerful* argument against phonography." A perverse inference from a correct premise. "For nearly fourteen centuries of our Christian era but few persons in France and Germany could write, and how was it possible to judge of *words* and their etymology without *seeing* them?" Dr. Latham says—"To those writers who, denying the affinity between the Irish and Welsh, can identify the Erse with the Hebrew, I apply the term *nyctalopia*—the power of seeing best in the dark." Yet an Irish laborer who had acquired Welsh in Wales, when asked some questions about his own language, stated of his own accord that Welsh was "a good deal like it." And yet how different: but *his* language instinct had not been extirpated, and he could grasp the relations as readily as an American savage can disentangle an etymology in his vernacular.

317. *The Dictionary of Derivations;* or, an Introduction to Etymology, by Robert Sullivan, LL. D., T. C. D., meets with the approbation of "the distinguished Philologist and Anglo-Saxon scholar," Dr. Bosworth, and causes the Dublin University Magazine to "confess we have been startled at the extent of the ignorance of many previous writers on the subject." Dr. Sullivan, with many others, gives *divinity* (an older word) as from *divine*,

* Outlines of Comparative Philology. New York, 1853. See also § 6 *a*.

and he represents *b* and *v* as becoming "*g* soft" in passing from the Latin RABIES, ABBREVIARE, LUMBUS, to the French rage, abréger, longe,*—a transmutation which is almost impossible. So Graff thinks that V in CAVEA became *g* in *cage*.†

318. *Sullivan, Graham, and Lynd,* represent the dental consonant *l* as *frequently* passing into the labial vowel *u*, a phenomenon of which we do not recollect an example. They cite for it Latin SOLIDARE, French *soudre* (to soder,) and Latin ALTUS (high) compared with the French vowel *haut*. These are examples of the loss of *l*, as in *calf, folk*, (perhaps absorbed by *d* and *t*,) and of the vowel change of O to U, (as in *gold, goold*,) and from A to O, (written *au* in French.)‡ But such authors mistake characters for elements, spelling for etymology, and the flourishes of the writing master for the modifications of speech.

319. *According to Sullivan, h* is prefixed in passing from the Latin OLEU^{m} (oil) to the French *huile*, which has as little aspiration as the English word *oil*. G is said to be inserted in 'Bretagne' from BRITANNIA (although there is no addition whatever,) and in 'grange' from GRANUM, which could not have produced it, although GRANarJum might. Nor is there any change from *v* to *g* in DILUvJUM *deluge*, or of *b* to *g* in RUBEUS *rouge*. In fact, it is difficult to see how SALVARE sa*u*ver should be considered a transmutation of *l* to *u*, and RUBEUS roUge *not* be regarded as the same law applied to *b* and *u*—although both views would be equally incorrect.

320. The magazine quoted, praises Dr. S. for the extent to which he has referred English words to Latin originals, and Dr. Bosworth, in the kindness of his heart, says,—"I wish you would turn your attention to the Anglo-Saxon, German, or Teutonic part of our language. You have well proved our obligations to the Latin and Greek." Among these, *haugh-ty* is referred to āl-tus, although it is akin to *high*, Belgian *hoog* (hōgh) with a guttural which ALTUS cannot account for. *Hawk* is referred to Latin fālco, instead of Anglish *hafoc*, Welsh *hebog*, English *hobby*. Finally, he pronounces Richardson's "far the best, and, indeed, the only complete Etymological Dictionary of the English Language that has yet appeared."

321. *Fine* (a mulct) is referred to Fīnĭs, end, limit; but (with the law Latin FINIS) it seems to be a different word, the Gr. ποινὴ (a fine,) Latin Pōenă, pain, punishment; pūnĭo, I punish. Compare Pătĕr and Father.

* But compare *lendes* (loins) of Chaucer, German *lende*, Lat. CLUNIS,—REGIO VEL PARS LUMBEA, the lumbar (loin) region or part.

† Althochdeutscher Sprachschatz, vol. 1, p. 614.

‡ The obvious explanation of these examples may be found in Böhtlingk,—über die Sprache der Jakuten. St. Petersburgh, 1851; p. 4, note 9. He cites *galdere, aldace*, &c., of the Florentine dialect, for *gaudere* and *audace*, as a change from *u* to *l*; but it is rather the loss of *u* and the eduction (§ 208) of *l* from the cognate *d*.

322. *Bead* is akin to bud, button, Hindustanee *pot* a bead. "Supposed from *beten, biddan,* to pray, from the use of beads in Catholic countries." Webster, Richardson, Tooke. Yet, beads must have been invented, named, and used for ornament in all countries, antecedent to such a collateral purpose.

323. *Notiophilus.* Some years ago the authorities of the State of New York permitted a large sum of money to be paid for the publication of a worthless quarto volume, devoted to the Entomology of that region. The author was for thirty years a professor of natural history in a college in Massachusetts, and therefore competent, one should suppose, to work out the technical etymologies of the science which he professed—for these are all spelt according to rule. Nor was there any necessity to deal with etymology, as the book was about insects, without regard to the meaning of their names. This official work, published "By Authority," is alluded to here, to show *how little use can be made of an etymologic orthography,* even by the so-called "educated" classes about some of our colleges. Here *Notiophilus* is rendered "notion beetle," from the Latin nōtĭo a notion, instead of *wet-lover* from νότιος wet, φίλος lover. *Anchomenes* (from ἄγχω, to squeeze the throat, because the insect has a narrow neck,) is made "ditch beetle," as if from ἄγκος, a cleft. *Aphodius* (named from inhabiting filth,) is made "footless beetle," as if from α (not,) ποῦς (foot,) the insect being a good walker and flier. *Cucujus,* (from the South American name *cucujo,*) is made "mixed beetle," as if from κυκάω. *Coelioxys* (meaning pointed abdomen,) is made "ceiling wasp," &c. The 'Entomology' is equally worthless.

324. *Entomóstraca,* the name of certain minute Crustacea, some of which have a bivalve shell, is derived from ἔντομα, insects, ὄστρακον, a shell, but in Macmurtrie's Dictionary of the terms used in natural history, they are said to be thus called, because the shell is divided into numerous segments; and the Greek μάμμα (a mother) is given as the etymology of *mammalogy,* which science would be thus made to treat of animals with mothers.

325. *Arquebus.* The Latin ārmă first meant tools of husbandry, next those of war. In German 'armschütze' (from the roots of *arm* and *shoot*) is a crossbowman; and 'armbrust' is a crossbow, as if connected with *arm* and *breast,* from a mode of holding the weapon, the stock of which was tubular, with a transverse groove to allow the string to drive the arrow or ball.

French 'arquebuse;' Norman 'arbalest;' Ital. arcobugio and archibuso (as if from 'arco' a bow, and 'bugio' a perforation, 'buso' pierced;) English arquebus, arblast, awblast, harquebut, haquebut, hackbut, hagbut, hagbush, haque, hack, hake, and demihake. Compare German 'doppelhaken,' as if *double hook,* double the size of the hakenbüchse.

Belgian 'haakbus' (as if *hook tube,* as 'vuurroer' is a gun or *fire tube.*) The Belgian 'bus,' (German 'büchse,' a box, pipe, gun-barrel, and gun; Gr. πυξίς, Eng. box,) occurs in

fowling-*piece*, and blunder-*bus*, a blundering perversion of 'donderbus,' as if *thunder tube*—all of them being used heteronymically, i. e., by transfer of idea as in sparrow-grass for the older sparagus.

Originally applied to the cross-bow, these names were extended to portable fire-arms when these came into use, the general appearance being the same. In some cross-bows, as in the first muskets, the stock was straight, and held on the breast in shooting. Those with a crooked stock were associated with *hook* by the Germans, who invented this form.

"*Arquebuse* Fr. from *arquer* to make crooked, and the Teutonic *bus* a pipe, a gun, &c. Hence the word means a hook gun."—*Webster.*

"*Arquebuse,* Sp. arcubuz, composed of *arco,* an arc or bow; and *busio,* which signifies *hole* in Italian. (Menage.) But the etymology of busio is unsettled."—*Richardson.* For *Hackbut,* Richardson quotes Lodge thus—"from *haque,* a term of unknown derivation, and *buter,* Fr. to aim at."

The ancients had various engines for casting missiles, named BALISTAE, (from *βάλλω*, I throw,) some of which were on the principle of the cross-bow. We find also the ancient term ārcūbālīstă (or with *ll*,) which, with the aid of otosis, elision, and heteronymy, arising out of the varying use and changing shape of the weapon, will account for all the forms cited. Poitevin assigns the Fr. arbalète to the Greek intensive *ἄρι*, and *βάλλω*. Graff assigns 'armbrust' to ARCUBALISTA, but also suggests *arrow* for *arm-*.

The elision of *cu* and eduction of *m* from *b* of the original, made the heteronymic *arm* of 'armbrust' (a word which is in *Trench*,) and the mutation of *l* to *r* accompanied *balist, b'list* in suggesting *brust,* or its dialectic form in the Nordish 'armbrysti.' By these means the bow became an *arm,* and a 'thrower' a *breast;* whilst a pistol-shaped, gun-shaped, or crooked handle, required that an 'arc' in one language should be considered a *hook* in another.

A R C U - B A L I S T A
a r .. .. b a l e s t ..
a r .. .. mb .. r u s t ..
a r .. .. mb o r .. s t ..
a r q ue b .. .. u .. t ..
a r q ue b .. .. u s .. ..
h a .. c .. b .. .. u .. t ..
h a .. c^k .. b .. .. u sh .. ..
b .. .. u s .. ..
p .. .. ie c .. e

326. *Pistol,* Bohemian root BA, whence the infinitive ba-ti, to speak; pe^vti, to sing; beseda, discourse (fatka, a parasite;) wyr, wejr, an owl; weyt, to howl; weysk, a shout;

wyrᵛek, pronunciation; báj, a ba-bbler, fi-bber; baje (Pol. bajka,) a fa-ble; peᵛseᵛn, a song; basenᵛ, a poem; wáti, weᵛní, to blow; fujak (and wítr,) wind; wícher, a whirlwind; wích, a wisp, (Ger. wisch;) weᵛtrník, a sail; weᵛjir, a fan; péro (Pol. pióro,) a feather, a fin; perutᵛ, a wing; pych, to breathe; fauneti, to wheeze; pasari, noise; písk, a whiff, a quill; písák, a writer; pisatel, an author; pisᵛtᵛala, a pipe, (Lat. FISTULA;) pisᵛtadlo, a *pistol.* Akin are Polish bez, elder-tree; piszczel, a pipe.

327. *Doggerel,* a deteriorative formed like *mongrel,*—from the Germanic *dichter,* &c., a poet, and meaning bad poetry.

328. *Laudanum,* an otosis of *nodnum,* and a cognate of *anodyne.* Gr. adj. νώδυνος, neuter *ΝΩΔΥΝΟΝ,* relieving pain, anodyne. Webster and Sullivan refer it to LAVDO (I praise,) first assuming the spelling to be etymologic.

329. *C-lay-more,* Gaelic and Irish mōr (great,) Gael. claidhamh, Ir. claidheamh, Welsh cledd-yf (a sword,) c-led-r (a f-lat body,) ll-ed (breadth,) Lat. lātŭs, Gr. πλατὺς (wide;) Ir. leith-ead (breadth,) leithe (the shoulder blade,) Eng. p-late, b-lade, p-lot, p-lat, f-lat, s-lat, s-late, c-loth, lath, leather, ladle, b-road, sp-read, (and *led* with silent *d* in) buckler. An etymologic orthography like *bwgellyedr* and *cllyedheamhmor,* exhibits their mutual relation perfectly, to those who object to the phonetic spellings 'buckler' and 'claymore.'

329*a*. *Strumpet,* Irish striobuid; Gr. ῥέμβω to st-roll, *roam,* ramble; ῥεμβας, she who strolls, a strumpet. For *Maraud* & *Foray,* see § 265.

330. *Heyday,* perhaps Old Fr. haite (health,) haitie (healthy, joyous, gay,) Ger. heiter (serene, happy.)

331. *Grampus,* γρομφάς, S-CROFA, a SOW; SCRIBO, I scratch, write, (γράφω, γλύφω;) SCRUPUS, a sharp stone; CLUPEA, a herring, *from the sharp ventral scales.* The motions of the small cetaceans are suggestive of the wallowing of swine, and the shape of the snout and back are somewhat porcine; hence δέλφαξ a pig, δελφὶς a dolphin; porpus, from pork-fish, &c.

332. *Davit,* a cognate of *gaff,* from Sp. gavieta, by otosis.

333. *Well,* Latin bĕnĕ,—compare William and Bill; Dan. teLt; Eng. teNt. *Bad,* Lat. mălŭs. Similarly, bŏnus, mĕlĭŏr, and bēllus, are cognates.

334. *Transom,* in shipbuilding, a timber bearing some resemblance to a bench; TRANSTRUM, a bench for rowers, a cross beam; θράω I sit, (substantive dimin. θράνιστρον, of) θρᾶνος, a bench for rowers (the uppermost of three,) a projecting head of a beam.

335. *Fern,* πτέριν, πτερὶς, akin to πτερὸν, a plume, a wing, from πετάω, πτάω, to spread.

336. *Proper names* afford much etymological material. *Osrīc,* rich in oxen. *Hooke,* probably Hugo, exalted, high. *Hogg,* Hague, Hedge, Hedger. *Lightner,* Ger. leiten, to lead. *Forest,* probably Ger. Fürst, a prince, nobleman. *Forester,* probably Ger. Vorsteher,

a warden, a *Foreman*, which (as a proper name) may be Fuhrman, a wagoner. *Hartman*, a forester.

337. *North*, coarse, unfriendly. *Grote*, Belg. groot, great. *Hartley*, little heart. *Landseer*, probably Fr. lancier, a lancer. *Klenewater*, (not *clean*, but) little water, i. e., Brook. *Peck*, Beck, Ger. Bach, Isl. Becker, a brook. *Chilman*, kill, a stream.

338. *Chopping*, probably Dan. kjopen. *Cutlove*, Ger. Gottlieb, God-love. *Flashman*, a butcher, Ger. fleisch. *Redyear*, Ger. Rüdiger, *g* being English *y* in some dialects. *Vinegar* (in Pennsylvania,) probably Ger. Wienker.

CHAPTER XIV.

THE VOWELS.

A transcription will become more and more perfect the more nearly it represents the peculiarities of pronunciation, a result which must never be lost sight of, even though it be impossible to attain it.—*Eichhoff*, Parallèle des Langues. Paris, 1836, p. 486.

Such diversities of opinion convey no truth; such a multiplicity of statements of what has been *said*, in no degree teaches us what *is;* such accumulations of indistinct notions, however vast and varied, do not make up one distinct idea. *Whewell*, History of the Inductive Sciences, 1837, vol. 1, p. 240.

339. *If it is difficult to appreciate* vowel variations, it is still more difficult to convey an idea of them in writing; and even with the aid of speech, the teacher may be satisfied with an attempt in the pupil which is far from being exact. Indeed, unless the teacher has an accurate ear and cautious habits, he is not necessarily the best qualified to give instruction in the pronunciation of his own vernacular.

340. *Consonants may be recalled* in all their purity by associating them with the organs which produce them; but time wears away the impression of vowels, and prevents such as are newly heard from being referred to others heard in former years, so that opinions in regard to them must be adopted with caution.

341. *Vowels cannot be described* intelligibly until there is a scale or apparatus by which the exact amount of throat or lip aperture may be indicated, and until then, key words must be used, from which approximations may be deduced. Descriptions of vowels are commonly very loose. For example, Antrim, (Pantography, Philada., 1843, p. 38,) without citing a key word, describes one as "a full sound, seeming to turn back, or cant off from the fulness of *o*—" which to him was a clear account of the sound he assigns to the final of *who*, and the initial of *with*, but equally applicable to *awe*. There are twelve errors in his account of the German alphabet.

342. *Vowels are not musical sounds,* these being made by the varying tension of the vocal ligaments, the tension for the vowels seeming to vary but little, except in song. But as the vowels depend upon the varying capacity of the mouth and pharynx, and as this would modify musical tones, there is an affinity between the two.

343. *Vowels are related to the musical scale* of the cavity of the mouth, as determined by the jewsharp, or in whistling, which, in the same person, have a different compass from the song notes of the glottis; and as the whistling compass comprehends about two octaves, the speaking compass may be assumed as the same. This is the proper basis for a comparison of vowel and musical pitch.

344. *In the vowel mechanism,* although most of the vowels may be produced without exhibiting the more obvious changes in the organs accompanying them, yet their production in the natural mode is accompanied by certain conformations which are useful as collateral indicators. These affect the lips, jaw, tongue, and larynx, the two latter receding and advancing a little to enlarge or diminish the vocal tube or cavity, and of this the tongue is the index. Thus, the advance of the tongue to the teeth in I, E, shows a reduced vocal cavity, whilst its withdrawal in A, O, indicates its enlargement. By this criterion, of the vowels *up*, *at*, the former is placed nearer to A, although *at* is by many considered as a kind of A.

345. *From the opening of the lips* by the retraction of the lateral angles required for I, to their closure for U, there is a gradual series of changes, the principal steps of which correspond with I, E, A, O, U. Of these, I is, in musical phrase, the highest, the vocal cavity being diminished by closure, and its length curtailed by contracting the angles of the lips.

346. *The jaws open gradually* as the lip opening is narrowed from I through E to A (or if this is not sufficiently open, to *awe*,) when they close towards O and U. But Tschnirschnitz makes the jaw opening continue from I to U; and we can unite the jaw position of *awe* to the lip position of O or U, giving rise to sounds which may occur among such as are described in books as "*o* approaching *u*," or "*u* approaching *o*."

347. *There is this difficulty* in determining the vowel by the jaw opening, that the same vowel is not restricted to a particular opening. Thus *add* requires a smaller opening than A, yet A can be made with the opening of *add*, which may be made with the external aperture of I; but in both cases the additional space required is secured in the pharynx, as proved by the retraction of the tongue. If, therefore, we pass up the vowel scale from A to I, or down from A to U, without opening sufficiently for A at the commencement, we shall find the mouth shut at the extremes of the scale.

348. *In measuring the jaw aperture* (by means of a graduated wedge inserted between

the teeth,) it has been found that *e*bb requires about $\frac{1}{4}$ inch; a*dd* about $\frac{5}{16}$; and A, *awe*, from $\frac{6}{16}$ to $\frac{8}{16}$.

349. *This has a practical bearing* on the proper determination of the state and position of a vowel, for as any one may vary a little in aperture without being considered distinct, we must determine or assume a certain phase as normal, and then add a mark for the closer and more open phases. The open phase might be represented by the minute circle used by Lepsius for open consonants, and the close phase by a minute *plus* mark. For example *ō*-bey and *o*dd have smaller apertures (are higher notes) than *owe* and *awe*, and they should have some distinguishing mark, but shall we consider *o*dd the standard and give *awe* the opening mark, or do the reverse, and mark *o*dd as a close *awe?* Shall *w*orth be considered a closer *w*orm, *u*rn, or as the normal form?

STOPT VOWELS.

350. *The name of stopt vowels* has been given to certain short English sounds, a term likely to mislead if it is taken to mean a particular kind of vowels, rather than an effect to which any vowel may be subjected, whether connected with other elements, or detached. Thus the short vowels of *it, add, odd, obey,* may be detached and lengthened, without falling into *ee*l, *a*rm, *a*we, *o*we; *e*ight is nearly as much stopt as *et*, and there is no more difference in the vowel effect between *it* and *eat*, *lid* and *lead*, than between *load* and *laud*.

351. *In some languages there is a staccato* or stopt effect, as in Chinese, where Medhurst (Dict. p. xxxviii.) writes a syllable kăh,—"the presence of the *h* however does not intimate that the latter part of the word is aspirated, but only that it is contracted and suddenly stopped, before the full sound of the word is completed."*

351*a*. *These stopt vowels* occur in the West African Grébŏ ('the active race,' grĕ a jumper, climber, a monkey; bŏ kind, race,) as in so.pló' the upper arm, (so. arm;) cŭná' knee, γόνυ; cvàcŭrí' palm of the hand (cvă hand, cŭrí' belly; bo leg, bó··cŭrĭ sole of the foot; cva··ca back of the hand; bo··pl··ó foot, a trissyllable, § 168. See the 28th, 29th, and 30th words of the Lord's Prayer in Cherokee, § 624; but the proper mark for the stopt vowels is one which is difficult to print with ordinary type—a Greek aspirate (') inverted (,) and raised to the top of the line. The notation here is that of this essay, with *v* as English *w*.

QUANTITY.

352. *The length of vowels*, and in some cases of consonants, is a most important point of notation, without which books cannot be read as a native would read them, unless the reader has acquired a knowledge of the words independently.

* Perhaps this effect should be indicated by whatever mark is used for the Chinese final *p, t, cay,* (§ 171,) when the breath is not allowed to pass after the consonant, as in allowing the lips to remain closed at the end of *tap*.

353. *Length of syllable* derived from consonants requires no special notation, to show, for example, that *string* is longer than *ring*, and *strips* longer than *rip*, *trip*, *trips*, *strip*.

354. *The length is relative* in vowels,* the longs and shorts becoming shorter in rapid discourse, and longer when it is retarded. But for the sake of illustration, we will assume that vowels have an absolute length. Probably the limit of shortness is about $\frac{1}{12}$ of a second of time, that is, the syllable *ta* cannot be repeated more than thrice in $\frac{1}{4}$ of a second.

355. *The length of a short vowel*, as in *it*, *at*, *et*, *ot*, *ut* is $\frac{1}{4}$ ($\frac{2}{8}$) of a second, but the syllables *is*, *as*, *us*, *ess*, *ox*, are half a second long on account of the continuous consonant.

356. *Long vowels*, like *ah*, *oh*, *owe*, *awe*, *oo-ze* are from $\frac{5}{8}$ to $\frac{6}{8}$ ($\frac{3}{4}$) of a second, the latter being 90 of Mälzell's métronome, with which, and with a watch beating quarter seconds, these results have been obtained.

357. *Medial vowels* are $\frac{3}{8}$ to $\frac{4}{8}$ of a second long. The vowel of *awn* is long, of *on* medial, and of *hŏnest hŏnor* short. There has been much error and confusion in English phonotypy from neglecting medial vowels, especially between *awe* and *odd*. These have been discriminated rather by length than quality, the close lengthened form of *odd* being considered the open *awe*, and the latter, when abbreviated, marked as the close *odd*. Some words have been written both with *awe* or *odd*, as George (Geŏrge Phon. J. June 1847, p. 180; Geōrge id. p. 276; wār, id. 1846, p. 129; wăr, p. 287;) or, for, short, alter, horse.

358. *The following have been spelt* with *awe:*—*au*thor, *au*thority, exh*au*st, f*a*lse, *a*lways, *a*lthough, th*ou*ght, qu*a*rter, B*a*ltic; and the following with *odd:*—*o*n (the key word with some) sw*a*n, m*o*rn, w*a*rn, cr*o*ss, acr*o*ss, l*o*ss, l*o*ng (cf. Ger. lăng,) w*a*s, *o*ften, *o*rthography, c*o*ffin, *o*rder, G*o*d (cf. gŏt,) J*o*hn, w*a*nder (cf. wŏnder,) h*o*g (cf. hŭg, bĭg.)† Compare the quantity of

or	ore	hog	hawk	
swan	swoon	alter	older	
on	own	short	hŭrt	fŏrt
horse	hŏarse	cross	crease	crŭsty
long	lung	morn	mōurn	bŭrn.

* Ellis, Essentials of Phonetics, London, 1848, § 9.

† "There are great varieties of opinion and practice respecting the vowel in the words cited, both in England and America. There may be a real difference between *awed* and long *odd*, the latter may be closer. . . . Some of the differences you name arose from Mr. Pitman (speaking by dictionary) preferring a close sound and a stopt vowel in cross, loss, gone, often, office, where a long or medial vowel is often or generally heard in London. In long we never lengthen *o*. The word god has the vowel unhistorically lengthened by many," but not opened into g*a*ud. "Before *r* there is a dispute as to whether a long or short vowel should be placed. Isaac Pitman, who cannot trill an *r*, prefers the ancient short vowel, which to my mind can only be properly used before trilled *r*. . . . I cannot help thinking that in your experiments on the length of vowels, you must, by the process of measuring the time, have been led to take the consonants into account."—*A. J. Ellis, MS.*

NOTATION OF QUANTITY.

359. *The Romans considered the vowels* as naturally short. They are naturally long, the consonants being naturally short. Long vowels were the first discriminated and supplied with characters, and in alphabets which do not discriminate between the two, it is safe to infer that the character was made for the long sound.* Theoretically, therefore, there should be no necessity to mark the long vowels or the short consonants.

360. *The marks of quantity* should be placed above or after the characters, the former being preferable. In the latter case the mark of accent should surmount that of quantity. The number of diacritics would not disfigure the page, provided each were significant. It is only when they are meaningless that marks offend the eye, as in placing five dots over rijiditi, and yet these dots would not offend in a line of staccatoed music. Böhtlingk has many Jakutish words in a modified Russian orthography, as kypÿöjäx (a deserter,) where 'p' is *r*, and 'x' χ. Sometimes these dots are surmounted by marks of length. Castrên has Samojedic spellings like küjü (birch) üjü (foot;) and there is a lake Abijijis in the State of Maine, and Ujiji in Africa. Compare Fiji, ὀρρὸς (whey,) and Turkish qyjyq (oblique,) a form which shows that strangeness of appearance is as much due to new combinations of familiar letters, as to new characters.

361. *If the longs and shorts were marked* (¯˘) the medials might be left unmarked, including such about which the writer hesitates—or, these might be marked with a superior dot (a·) immediately after the letter. In Hebrew, three degrees of quantity are recognised, long, short, and very short; and in Sanscrit a figure 3 is used to denote a very long vowel. Let us use figures to denote length in approximate or nominal eighths of a second, as in f a^2n a^2t i^2c, f a^3n, a^5r m (including the quantity of *r*,) O^8! is a full second, or a beat of the metronome at 60.

362. *In the following Cherokee* read **c** as *k* flat (§ 181,) e strictly as in *they*, *weight* (avoiding *e*bb,) a in *art;* ı as in *it;* o strictly as a true short O in *note*, *obey;* and V as English *w*. Then we have—

ce^2hı$^{2\prime}$ (**c**ĕhı′) *far*,	**c**e^8hı$^{2\prime}$ (**c**e^8hı′) *very far*,
na^3**c**vo$^{2\prime}$ (na**c**vó) *near*,	na^8**c**vŏ′ (nā**c**vó) *very near*.

363. *The Cherokee word for wind* (used figuratively for *smoke*) has the three vowels of *foot*, *war*, *ebb*, (ŭ, ɑ, ɛ,) that of *war* being the open vowel of *awe*, with a medial quantity. the word is ŭ^{2}nɑ^{3}lé, and it occurs disguised in the following word, where medial vowels

* "In most languages the short vowels are not so accurately differenced as the long ones; this is the reason why the former were not indicated at all in the most ancient languages."—*Lepsius*, Alphabet, p. 51.

are unmarked, ʊ in *up*, pure and nasal, i in *feet;* the acute accentual marks *a short accented vowel*, and the grave would be used for a long one.

tĭcvʊ̆tʊ̆nɑlʊ̆tēstʊ′—

used by an old chief at a council, and incorrectly rendered by the interpreter—" the wind blowing from my direction will indicate where I am"—because the ordinary word for *smoke* was replaced by that for wind. On the prairies a column of smoke is a prominent object which may be seen at a great distance. The speaker wished to convey the idea that—"the distant smoke ascending from my fire will inform you where I am," or, "the smoke at a distance will rise in the air from the place where I am," tĭ, *at a distance*; cva[3] connects the subject with the speaker, the next *t* is probably a fulcrum to prevent the concurrence of the two vowels: tēstʊ′, *shall be blowing*.

364. *Quantity can be indicated* in two other modes, and although the appearance of a printed page (whether of speech or music,) is secondary to its accuracy in depicting definite phenomena, these modes will offend the eye less than the normal Latin mode. There are three variations in the width of type, named *extended*, *medium* and *condensed*, and these would answer extremely well for the three lengths of vowels, except that ɪ, i, are not distinct.* The following are examples:—

Extended,	A E I O U Y	a e i o u y.
Medium,	A E I O U Y	a e i o u y.
Condensed,	A E I O U Y	a e i o u y.

465. *In Italic typography*, the termination of *a, e, i, u,* might be cut off at its lowest point, and be supplied with a separate type like that used to add a little flourish to finals in script printing. This addition could be broader or narrower according to the length of the vowel.†

366. *Quantity is influenced by consonants.* Sonants, which have length themselves, may accompany long vowels, and surds may accompany short ones. In the following pairs, the second is longer than the first; and in German, zeichen *token*, is shorter than zeig-en, to in-*dic*-ate.

* "As short vowels and consonants are generally more frequent, it is practically most convenient to mark length only. . . . The condensed, medium, and broad-faced type would be very troublesome to distinguish accurately by the eye. I do not think you would approve of it if you had twenty pages of such type (especially in small fonts) to read." *Ellis*, MS.

† An economic provisional typography could be made by using italics (or small Roman letters) and spaces, but excluding capitals. Let the first and second line of *u, n, r, a, d, p, b, g, q, y, h, k,* be formed of separate types, some of them meaning nothing except in combination; let a few new marks be made (like _ to form ɪ_ for *i*, to avoid the dot,) and let the required letters be built up from these, as in music printing. Dr. Rapp (Grundrisz, Vol. II., p. 8, &c.,) has formed in this manner a character for *ng* out of *ŋ* (inverted italic *l*) the two members being not quite in contact.

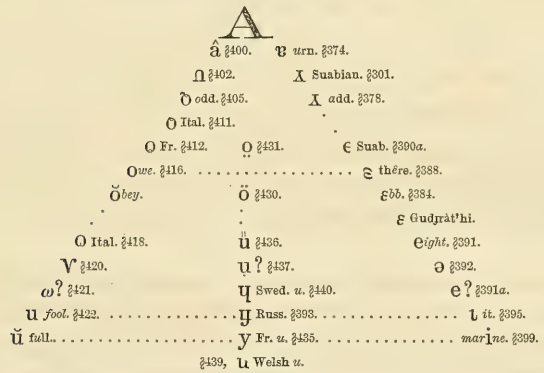
fĭerce	fēars	lĕaf	lēave	strĭfe	strīve	heīght	hĭde
late	laid	leak	league	bat	bad	joint	joined
rope	robe	feet	feed	hart	hard	lout	loud.

367. *Consonants have a recognised quantity* in Dacòta, where *s* and *sh* occur short and long. "When marked thus (s') the sound is prolonged." (Riggs' Dictionary, Washington, 1852.) Thus s'a (sh˘a) is *red*, and s''a (sh¯a) to *shout*. Dr. Lepsius has improperly transferred the mark of shortness to '*s*' to represent English *sh*, and to '*z*' for *zh*. *a*. The *n* is long in Italian sĕdéñdo púñto (point,) but not in Spanish, which has it in 'Cervantes' =θĕrɩáñtɛs, where it bears the accent.

368. *The length of continuous consonants* may vary with the sonant or surd phase of the succeeding one, as the short secondary vowels are seldom lengthened in English. The following are examples of n, l, ng, r, m, s, thus lengthened.

sin˘ce	sin¯s	han˘k	hang¯d	blur˘t	blurr¯d	dam¯pt	dam¯nd
pinch	impinge	pence	pens	else	ells	dos˘ed	doz¯d
dint	dinned	wilt	willed	start	starred	etch˘t	edg¯ed.

369. SCHEME OF THE VOWELS.



370. *The most characteristic* of the vowels is that in *arm*, *art*, *father*, commonly named Italian A. It is almost universally represented by its proper letter A, a, *a*, which cannot be departed from except to degrade the system of notation, and in some degree to injure the etymologic uses of the Roman alphabet. For if 'A' may represent an E sound to accommodate some English words, it should represent O (as in *nose* from nāsŭs,) to accommodate those languages where the interchange seems to be on the labial side, as in Russian, Tawgy-Samojedic (Castrén, § 7,) and Hungarian. (Dankovszky's Lexicon, 1833, p. 10.)

371. *By corrupting* 'A' to an E power, and refusing to show that I and U have acquired it in becoming A:J and A:V; or, by exhibiting 'A' as the representative of a closer sound than it was made to represent, and by keeping back the coalescent consonants to their vowel basis, instead of representing diphthongs by their true elementary characters—the English vowel scale is attempted to be kept within the range of nos. 2, 3, of the scale in § 246–7.

372. *The following are inscriptive forms* of A, the first being the Phenician and Hebrew original, after the hieroglyphic form was left. The others are Greek.

1 2 3 4 5 6 7 8 9 10

Of these, nos. 2, 9, justify a, *a;* and a form based on '&' with the upper loop removed; nos. 4, 5, would justify capitals on these bases, and the Phonetic Journal character, an a reversed (the loop on the right) for the small letter; and nos. 4, 5, 6, would round into an italic *v*.

373. *The Sanscrit analogue* of Latin A is assigned the power of *u*p by Sir Wm. Jones, and by Wilkins (Sanscrit Grammar, London, 1808.) When it is long, the latter says that—"in kāld *time* the first syllable is pronounced nearly like the English word *call*—" a sound which Vans Kennedy says "does not exist in India." He says too, that "North of the Krishna the short *a* is like *u* in *sun*, south of it, long *a* is pure, and the short sound as in *hand*." The vowels of *up* and *at* are extremely doubtful as Sanscrit elements. The proper character for A (a, *a*,) is used by Pickering,* 1831; Eichhoff, 1836; Comstock, 1846; J. P. Hart's World's English, (Newhaven, U. S., 1851;) Müller, 1855; Lepsius, 1855; Ellis, 1856. In the local English alphabets, Pitman (Phon. J., 1857,) and Graham (Phon. Quarterly,) use a reversed a; Masquerier, (New York, 1847,) italic *a*.

ʌ, ɐ, in *urn*.

374. *Many languages want this vowel*, which is so common in English as to be regarded as the characteristic of the vowels. It has not been assigned to Greek, Italian, Spanish, nor German, but it occurs in dialectic German. It has nothing to do with the labial vowels O, U, and to represent it by an *o* or *u* character would falsify its affinities. It is close (ɐ) in *up*, *wŏrth*, and open (ɐ) in wŏrm, wŏrd, urn. The effect of *worth* is that of a short syllable, each element being short, (the *r* close;) whilst *worm* is long on account of the open and longer *r*. The vowel *u*p is nasal in the French *un;* but M. Pantoléon (in Comstock's Phon. Mag.) makes this a nasal *eu* in *jeu*, and Lepsius refers it to German ö.

375. *In the writer's French* pronunciation, *u*p is placed in mĕ, quĕ, quĕrelle, &c., according to the view of most French grammarians, but Lepsius and Ellis consider it a variety

* On the adoption of a uniform orthography for the Indian Languages of North America. Memoirs of the American Academy, 1831, iv., 319.

of *ö* or *eu*, in which they may be correct. Lepsius writes it *ǫ*, and Ellis (preferably) with a reversed (not inverted) e character.

376. *The character chosen* is sufficiently distinct, even were the sound not allied to A and E. A script form can be made without raising the pen to make the loop, and it may recall *r*, with which ʊ is allied. In fact, there seems to be a palatal (or middle mouth) *coalescent* in Irish, between *u*p and a short open smooth *r*, as in the monosyllabic word GʊĒ *wind*, as distinguished from GĒ goose, but the former word varies dialectically. The effect strikes the ear somewhat like *gŏ-way*, *go-ay*, compressed into a monosyllable; but there is no *o*, *oo*, *w* sound. This element requires verification in nature, as it has not been heard recently, and the language has been very seldom heard.

377. *Ellis represents the vowel of up* by ə;* Max Müller by a cipher 0; Lepsius by *ǫ;* Bishop Wilkins (Real Character, 1668,) by y with a terminal flourish; Hale † by a character like inverted *Ω*; Rapp, *ə;* Pitman, ᵊ; (Comstock, U, u; Longley, U, u; Antrim, o; and H. M. Parkhurst, u (Ploughshare, Boston, U. S., 1853.) It is doubtful whether the modification for open and close, should be made in the upper hook or lower dot; but the former is preferred, because it leaves the character more distinct from e.

Ʌ, ɪ, (ɑ, æ,) in *add.*

378. *With very little affinity* to A, this sound usurps its character in some alphabets. It is more nearly allied to *e*bb, but not enough to have a letter on the same basis, like that of Lepsius. Rapp writes it ä; Comstock, A, a, Hart ä, Masquerier a, a; and Pitman, Graham, Parkhurst, Kneeland, and Longley A, a.

379. *The people of Bath, England,* are said to pronounce the name of the town long (= bɪθ‡) and it is strictly long and short in Welsh, as in bɪ̆χ a hook; bɪ̄χ little. It seems to be lengthened in the following words, but as the author speaks this dialect,§ the observation must be accepted with caution.

* Universal writing and printing with ordinary letters, Edinb., 1856.

† Ethnography and Philology of the U. S. Exploring Expedition, 1846. A valuable work philologically, but not phonetically. He does not think it necessary to indicate French *u;* he uses A for the power in *mart, mat,* (but, probably, did he hear the latter;) E for *fate, met;* I for *machine, pin*—p. xii. 1846.

‡ The Rev. J. G. Woods (Sketches of Animal Life, 2d Series, London 1855, p. 247,) mentions "The singular mode of pronouncing the word which is used by those who have resided there. Instead of enunciating the word Bath in a clear and open manner, it appears to be correct to elongate it into an effeminate drawl, thus—B-a-a-a-ath, pronouncing the vowel like *a* in *cat.*" "The sound is common over Wilts and Somerset, and it may extend to Gloucester and *South* Wales. . . . The long sound is the name of the first letter of the alphabet in Irish English. . . . Our ladies *often* say *graas, caalf, haalf, paas, aask.* Many orthoepists (Worcester and Bell,) have recognised an intermediate vowel."—*Ellis, MS. note.*

§ Heard in Philadelphia, and used by Walker, who puts his a^4 of *fat,* in grass, grasp, branch, grant, pass, fast, the proper sound being probably French â, as in pâss, &c.

pān	pănic	dām	hăm	mādder, *adj.*	mădder
band	banish	dram	ram	ma'am	mammon
fan	fancy	lamb	lamp	baa	badger
man	tan	bad	pad	gas, gaz	gash, as
can, *n.*	can, *verb.*	glad	lad	lass	lash
bran	ran	bag	tag, beg	brêad	bred
Ann	an, Anna	cag	wag, keg	dead	Dedham
Sam	sample	drag	dragon	bed	sped.

380. *It occurs in provincial German,* as in bɅ'rɪc, (with the vowels of bărrĭer) for *berg* (bɛrG) a hill. A native of Gerstungen (= Gérstŭ/ən) in Saxe Weimer, pronounced the first syllable of this name with Ʌ in *arrow.* Compare thatch, deck; catch, † ketch; have, † hev; scalp, † scelp; German and English fett *fat;* krebs *crab;* fest *fast,* adj.; Gr. τρέχω (I run,) *track.*

381. *It has a long and open* German provincial (Suabian) form, being used for long open ä (ê) as in bɅ¯r (bær) for bär, (a bear.) This bears the same relation to *a*dd that French ê in même bears to *e* in *memory.*

382. *This vowel is nasalised* and short in the French *fin* (end) =fɅ̨; *pain* (bread) = pɅ̨. But some consider this a nasal of *e*bb,* either because such a sound is used, (the Polish ę?) or because the French (being without the pure *a*dd) refer their nasal *in* to the nearest pure sound known to them.

383. *The character* ɅA *is a good one,* and may be written with Greek α, into which '&' degenerates in writing. The Anglish æ is accessible for the open sound, whilst a small '&' would admit of being trimmed into several distinct shapes for varieties of sound.

ɛ, ɛ̂, in *ebb.*

384. *Most writers pervert* 'e' to the use of this sound, an error which arose from regarding the vowels of *they them* as variations in quantity. If the Roman alphabet is to be adhered to (ϵ) the half of 'e' might be used for it, but a Romanised form of Greek ε (like that of Mr. Pitman) is much to be preferred,—and it is shown as a Greek form in Franz, p. 245, line 10 from below.

385. *The secondary vowels i*t, *e*bb, were not allowed to Latin, (§ 93) because there is no evidence that they were Latin sounds; and although *e*bb occurs in Spanish† (as in el *the,*

* Value compares nasal *in* to English *ain* in *faint;* Bolmar to *en* in *length;* Gouraud to *en* in *lent;* and Picot to *an* in *vanquish.* Pantoléon puts the *e* of 'thêre' (nasal) in Fr. *point, pain, sein,* and of 'end' in *bien, moyen.*

† Even this is not admitted in Cubi's "Nuevo Sistema" (of English for Spaniards,) published by I. Pitman, Bath, 1851—where the vowels of *ill, ell, am, up, olive,* are not provided with Spanish key words; but he assigns the whole of them to Catalonian.

estē *this one,*) it is not near as frequent as an Englishman might suppose. The following examples are from Vingut's Spanish Grammar (New York, 1853,) with his pronunciation in English spelling—but we think that some of these have ε.

paréntesis	pa-rain-tai-sees	tenedor	tainaidór
crisis	creesees	comodidad	co-mó-dee-dad
jeneral	hai-nai-ral	felicitar	faileetheetar
médico	mai-dee-co	Asiatico	Ah-see-áh-tee-co
tres (Lat. TRES)	trais	entre	aintray
frecuentamente	fraikwaintaimaíntay	pez (fish)	paith.

Nor has E become ε in French, where it might be expected from English Latin, as in élégant, éléphant, élégie, émétique, nécéssité, effacer, exact, et;—and for que, le, me, ne, de, cela, doucement, vivement,—Vadé puts qué, mé, vivément, &c., in the mouth of a Gascon.

386. *The vowel* ε *occurs in* Italian témpo, térră, Mɛrcùrĭŏ; in the German réchnung (a reckoning;) pelz (pelt, fur,) schmeltzen (to smelt,) rector (rector.) German short ä (ɛ) often falls into this sound, as in prächtig (sumptuous.) In Ellenic, ε and αι are alike, as in *set, said.*

387. *Frenchmen state that* ε *occurs* in elle, quel, règle; M. Value gives *get* as the key word for è and ê; Bolmar gives *mare* for è, and *there* (when emphatic) for ê; and Pantoléon puts *e* of *there* in est, les, vrai, mais, and that of *ebb* in elle, quelque, cher, superb, aime. He writes *tu avais* with the former, and *il avait* with the latter, whilst Bolmar makes them both è.

ɛ, ϵ, (ê, ϵ,) in *there.*

388. *The vowel of ebb,* with a more open aperture, is long and accented in the Italian mɛ dĭcŏ, tɛmpɛ stă, cĭêlo, and short in the verb e (is,) ăb-biĕt-to. It is the French ê in même, tête, fenêtre, maître, haie, Aix (=ɛ s,) air, vaisseau. The same sound seems to occur shorter in trompette, which is not the vowel of *petty.* It occurs in the Coordish fɛrd (a pack on a horse,) with smooth *r.* Volney writes it *ai;* Lepsius, ē (in "Fr. mère, Ger. bär;") Comstock a good character (§ 398,) but he considers it the representative of a double sound, as in thê-ur for *there.*

389. *It is the German* ä long in mähre (mare,) mährchen, fehlen, kehle, währe, but *wehre* has E long. The theoretic short sound (ϵ) falls into ε, as in ställe (stalls,) commonly pronounced like stelle (station.) In German, the letters ä, ö, ü, are sometimes more correctly printed with a minute (ᵉ) instead of the dots, and Zieman* has restricted the dotted characters to the short sounds, and the others to the long ones.

* Mittelhochdeutsches Wörterbuch, 1838.

390. *The character preferred* here is a modification of ε, being (ϵ) a form of Greek type in use, to be assigned to French è. If the Roman alphabet is adhered to, the type can be made by cutting away the right half of 'e;' and ê can be made in the same manner, retaining the circumflex,—or excluding it, and mutilating the type less than for è, giving it the appearance of Anglish ϵ. But (ꞓ) a character formed from (ω) Greek oméga, is preferred for the ê sound, and accentualised letters are not to be used to indicate quality. *a.* We quote here doubtfully, a Suabian open vowel perhaps between there and *u*p, and heard in *r*eiten, *s*eide, *w*eiss, *f*enster, stĕllĕ, and in rēgen (to move,) whilst rêgen (rain) has ê.

ɵ, in *vēin, ĕight.*

391. *The English ay* in pay, paid, day, weigh, ale, rage, is short in weight, hate, acre, A˘mos, A˘bram, ape, plague, spade. German wēh (wo,) rēh (roe,) jē, planēt, mēer, mēhr (more, but mähr *tidings* has ê,) ēdel, ēhre, jĕdŏch. The Italian "e chiuso" has this quality, as in màlĕ, ottóbrĕ (with "o chiuso,") but it is nearly always short. Most authors assign this sound to French é, called 'é fermé,' but Dr. Latham assigns this é a closer aperture, for he says—"This is a sound allied to, but different from, the *a* in *fate,* and the *ee* in *feet.* It is intermediate to the two." *a.* Dankovszky says the Hungarian "é est medius sonus inter e et i," but his 'e' is uncertain. Olivier (Les Sons de la Parole, 1844,) makes é identic with I in the position of the mouth.

ə in *-ment, -ence.*

392. *There is an obscure vowel* in English, having more aperture than that of *ill,* and less than that of *ail.* It is used to separate consonants by such an amount of vocality as may be secured without setting the organs for a particular vowel. It is most readily determined between surds, and it is often confounded and perhaps interchanged with the vowel of *up.* It occurs in the natural pronunciation of the last syllable of worded, blended, splendid, sordid, livid, ballad, salad, surfeit, buffet, opposes, doses, roses, losses, misses, poorer, horror, Christian, onion, and the suffixes -ment, -ant, -ance, -ent, -ence.

392*a.* Perhaps this vowel should be indicated by the least mark for the phase of the least distinctness (§ 484,)—a dot beneath the letter of some recognised vowel of about the same aperture. It is so evanescent, that it is often replaced by a consonant vocality without attracting attention, as in saying hors'z, horsz, horszs, or (using a faint smooth *r*,) hors^{r}z.

392*b.* *Rapp uses 'ə'* for this sound, and for the closér form allied to *u*rn, placing it in m*u*st, h*o*ney, *a*, *a*n, m*a*ster, f*e*ver. H. M. Parkhurst uses a tailed 'e' in prés*e*nt, conven*ie*nt, univ*e*rse, ord*e*r, and in the suffixes -er, -ent, -ency, -ment; and the vowel of *up,* in *u*p, m*o*ney, impress*i*on, occ*u*r, s*o*me. Longley uses e in *e*arth, v*e*rb, f*i*rst, p*e*rson, deserve, s*i*r,

skirt, thirty, verge,—using the vowel of *ebb* in very, discovery, another, interest, and that of *up* in worse; so that he can hardly have the Irish dialect in view. Graham proposes a peculiar 'e' for her, bird.

392*c*. *With Rapp*, we assign this vowel to German, as in welches, verlīeren, verlässen (or even frlásn.) The vowel of *up* is not admissible in normal German, although it is common enough in dialects, and associated with short *o*, as in *kopf*, *toll*. In our examples, the theoretical vowel is that of *ebb*.

Ꙋ, the Russian ы. (ꙋ, in Turkish.)

393. *This vowel strikes the ear* like the pinched German ö, ü, to which series it may belong; but the lips are not pursed, the effect being due to the enlarged cavity of the mouth. The quality is perhaps nearest to the vowel of *if*, but the jaws are more separated, and the lips are retracted as for I. It is long and short, and is said to be the sound represented in Polish by y. Eichhoff (1836) uses 'y' for it; Castrén (1854) the same, with an angular circumflex when long; and Ellis uses a small capital ʏ. We propose a character formed from inverted fi, which is sufficiently distinct, whilst it bears some resemblance to the Russian and Polish forms—and 'y' must be restricted to its historic value.

393*a*. *Castrén mentions this* as a Sămŏjēdĭc vowel, and he says that in making it, the end of the tongue is prest against the base of the lower teeth. § 344. He states that in several dialects, 'i,' in certain conditions, has something of this sound.

394. *This Slavonic vowel* occurs in Jakutish (Böhtlingk,) and is probably the key to an Altai-Tatar infusion, as it is said by Redhouse and Böhtlingk to occur in Turkish. But Sᵛuñic′, who quotes Turkish very freely, in illustration of the elements, does not admit it. We have not been able to compare the two, having heard them with an interval of six years. They are closely allied, and our impression is that the Russian phase is based on *oo*ze, and the Turkish on *is*.

ɩ, in *pit*.

395. *The English vowel of it, pit, pin*, &c., frequently formed out of a shortened I, and as 'e' is one of its equivalents, it often takes the secondary power, as in bĕlieve, rĕgret, dĕscend, which cannot differ from dĭspose;* and we find in old English—biginnan, 1250; began, bithoute, 1280, without the unenglish *gh;* and Chaucer uses dispise, discent.

396. *It is the German vowel* of kĭnn (chin,) hĭtzĭg, bĭllĭg, wĭll, bĭld; and the initial of the Belgian diphthong *ieuw* (and perhaps, in some cases, the Welsh *uw*.) It is adopted for the English *u* in *tube*, (tĭwb) in Comstock's alphabet—a diphthong known to the writer.

* See the Phonotypic Journal, 1846, for this vowel in select, secure, review, degree, defect, desire, dĭsease, denote, prepare, December, and many more.

397. The form is accessible in a mutilated (U, u, t,) and it will best suit the languages in which I, J, are used correctly, among which it is hoped English will be one. Thus the series J I U will exhibit normal I turning to J in the closing, and U in the opening direction; and there are good reasons why they should resemble. Their affinity causes an interchange in Chris-tian (cʀɪstᵛʒjən, -tᵛʒjən, or -tʃən,) with J, and Chris-ti-anity with U. Compare o-li-o, o-lio (ólɪo, óljo,) fil-i-al, fil-ial, foliate, folio; il-i-ad, il-iad, va-ri-ous, va-rious, cordial-ity, idiot, previous, devious.

398. *This vowel is commonly confounded* with I, but it has a more open jaw aperture, whilst each may be lengthened or shortened. When made long, it suggests long ɥ, but they differ. The following notations have been proposed for e in *they*, ɛ in *them*, ɛ̣ *there*, i in *he*, and ɪ in *his*.

	e	ɛ	ɛ̣	i	ɪ
Rapp, 1836,	ê	è	ä	î	i
Lepsius, 1855,	ē	ĕ	ẹ̄	ī	ĭ
Max Müller, 1855,	e	e	ä	î	i
Ellis, 1856,	e	ɛ	ɛɛ	i	ɪ̣
Pitman, 1856,	ɛ	e	ɛ	ɹ	i
Pitman, Jan., 1852,	"	"	"	ɪ	"
Graham, Adair,	"	"	"	ɹ	"
Kneeland, 1824,	á	"	à	è	"
Hart, 1851,	e	ë	ä	i	ï
Comstock, 1846,	"	ɛ	ɒ	x*	ɪ
Masquerier, 1847,	a	E		e	i
Antrim, 1843,	æ	a		"	y
Haldeman, 1846.	e	ɛ		i	ɪ
Reynolds, 1846, (§545)	"	"		"	"
Hale, 1846; Matushik, 1837,	"	e		"	i
Poklukar, Sᵛuñic′, &c.,	"	"		"	"

I, ɪ, *i*, in field.

399. *The universal* I, is long in Italian ìŏ (Lat. EGO, *I*,) and short in fĕlĭcĭtàrĕ, with true e. In English it is long in machīne, marīne, fīend, fee, tea, bee, grieve, eel. It is

* Perverting I to *eye*. In citing the powers of English 'i,' that of *marine* is omitted, and not because it is i-e, for *e*, and not e—e is cited for the power in *eve*. The sixteen tone marks of "Comstock's Perfect Alphabet" . . . . "not only represent *accent*, but *inflection* and *intonation* or melody." But as these differ as much as *stress* and *pitch* in music, they cannot be represented by the same mark in a rational system. The inflection of unaccented syllables is not marked, hence (p. 27) although "refined," and "region," close sentences, the final syllable of the latter is represented as unaffected, and the first syllable as falling, because this mark means both falling inflection and accent. This notation has been used by its author since 1841.

short in ĕqual, ĕduce, deceit, heat, beet, reef, grief, teeth. *German examples* are vīeh, wīeder (against,) wĭder (again,) wĭe vīel (how much,) vĭelleicht (perhaps.) It is medial in knie (knee.) *French examples* are surprīse, vīve, īle, stȳle, īl, vĭf, phȳsĭque, ĭmĭter, lĭquĭde, vĭsĭte, polĭtĭque, which must *not* be pronounced like the English *physic*, &c., with the vowel of *pit*. The following are perhaps medial,—prodige, cidre, ligue, vite, empire.

A, (ʌ, ɑ,) in *āisle, Cāiro.* (§ 372, 4, 5.)

400. *Proceeding in the labial direction* from A, the first element is French *a* in âme, pătte. The former is commonly received as the vowel of *arm*, the latter of *pat*. Duponceau* in 1817 made the distinction. He says that French *a* occurs in the English diphthongs *i* and *ou*, and that the sound is between *ah* and *awe*, being *ah* pronounced as full and broadly as possible without falling into *awe*. The initial of English *i* (or *e* in *hĕight*,) differs in being pronounced *u*p and *a*t; whilst the orthography '*ou*' was partly intended to represent the French vowel of *could*, and partly the Saxon (Plattdeutsch) diphthong, which we have heard, and consider to have the initial of *odd*.

401. Ellis uses *a* with a horizontal medial line for it, and Comstock ʌ, and a lower case form (ɑ) with the base open, and the left branch turned outwards. Pantoléon admits this sound when short, as in a, la, pas, ma, e^n, il a, and in both syllables of voila, avoir; but he places the true A in a^n, tu a, car, toi, voix, naïf, matelot. This is probably the proper vowel for grass, grant, pass, alas, (Fr. hélas.) See § 379, note. When accessible, we prefer Mr. Pitman's reversed a for French â.

Ɑ, (ɒ) in *awe.*

402. *This sound lies between* A and O, and is common in several German dialects, and in Bengalee, where nɑ'ɛ is *nine*. The Germans represent it very commonly by å, adopting the Swedish mode, where however the sound seems to be a kind of *o*. Franz, Epigraph. Gr. p. 246, line 1, has a Greek character very like ȣ.

403. *This* awe *is not to be determined* by its length, but by its quality. It is *long* in raw, flaw, law, caw, all, pall, call, thawed, laud, hawk;—*medial* in loss, cross, tossed, frost, long, song, strong, or, for, lord, order, border, war, warrior, corn, adorn, born, warn, horn, morn, storm, form, warm, normal, cork, wan, swan, dawn, fond, bond, pond, exhaust, false, often, soften, gorge, George;—and *short* in squăsh, wăsh, (cf. rush, push,) ăuthor, (cf. ŏath, pĭth,) watch, wăter, slaughter, quart, quarter, wart, short, mortar, horse, (cf. curse,) remorse, former, often, north, moth, fault, falter, paltry.

404. *For the vowel pair in awe, odd,* Ellis uses ȣȣ,† ȣ;† Comstock, Pitman and Graham ȣ, o; Bishop Wilkins Greek *α*; Hale ɛɑ in a single character; Hart and Kneeland O with a horizontal medial line; Parkhurst ȣ,† o; Lepsius ō, ǫ; Masquerier ɔ, using one sign for

* Am. Phil. Trans., 1818, Vol. I, p. 258.

† With the appendage on the right.

both, (like Wilkins, Hale, and Hart,) a sign made of b,—and d, p, q, would afford allied ones. For common typography, we propose ɑ, ɔ, with ει (closed) as the writing form of ɑ or its varieties.

Ɔ in *odd.*

405. *This differs from the preceding* in being formed with less aperture. It is *short* in not, nod, hod, what, squăter (cf. the open wăter,) morrow, borrow, sorrow, horror, choice, ponder, throng, prong; *medial* in on, yon, John, God, rod, gone, aught, thought, bought, caught, naught, fought, sauce, loiter, boy, and perhaps long in coy, oil. Some of these medials may belong to *awe*, and some of those to this head.

406. *The accuracy of these examples* is not expected to be admitted in detail, because practice between the two vowels is not uniform; yet it is probable that no one puts the vowel of *potter* or the quantity of *fall*, in *water*, which is neither wāwter nor wŏtter. In the following table, the medial examples have been chosen without regard to the vowel they contain.

gāud	God	nŏd	gnaw'r	nor	Nŏr'ich
awe	or	orange	rawed	rod	Rodney
fawned	fond	astonish	awed	aught	odd
thawed	thought	Thoth	laws	loss	lózenge

407. *In the next table*, No. 1 is the long, 2 the short, and 3 the medial quantity of *awe;* 4 is the medial and 5 the short quantity of *odd.*

1.	pāwned	wāw	squāw	yāwn	hāw
2.	ăuthor	wăter	squăsh	wănt	hŏrse
3.	po^{3}nd	wa^{3}r	swa^{3}n	wa^{3}n	ho^{3}rn
4.	ro^{3}d	Go^{3}d	thou^{3}ght	go^{3}ne	Jo^{3}hn
5.	pŏnder	bŏdy	squăt	hŏnest	hŏrror

408. *Indications of quantity* cannot be dispensed with here. ɔ, (or whatever character is used) might stand for the vowel of *odd*, and have a widened form, or a superior dot (·) *after* the letter, for its medials; whilst ɑ (or its representative) might be considered medial, and have a long mark for *awe,* since the medials of the close vowel, and the longs of the open one are the rarest.

409. *It is a difficult problem* to supply *awe* and odd with suitable characters. They have no more right to be formed on an 'O' than on an 'A' basis, and the available forms of 'O' should not be drawn upon too largely for English, being required for French *o,* the two Italian kinds, and perhaps others among described or undetected phases. *a.* ɑ, ɑ, or n, ɑ, would form a good pair, and they recall A, O, but ɑ is perhaps too much like n for blurred print. The preceding, with ɔ, are not sufficiently alike, because the medial

quantities may be confused by the same person in the same word. Other pairs are furnished by the rejected forms of the Phonotypic Journal, as ⊓, ⊓, or ⊓.

410. *The chief difficulty* is in finding approximate forms which can be readily made with the pen. One of the preceding forms might answer for the open sound of *awe*, and ꝏ (which approaches Gothic O,) for the close one. The 'A' part of the latter could be so much reduced as to make the character approach ꝏ, with the mark in contact. A pair like ꝏ with the upper or *o* part large for *o*dd, and 8 the lower or *a* part large for *awe*, would solve the problem in print, but they would be likely to take an *e* form in writing. A writing character formed of ει united, would answer for the *awe*, and the script *a* recommended for *aisle* (the middle of the *i* portion broken towards the left,) for the closer sound; or, the closed ει character (Hale's *aw* long and short,) might have the close power, and have the ι part descending in a short tail, for the open sound, or the ε portion with the break thrown to the left.

O, Italian "*o aperto.*"

411. *To an unfamiliar ear* this vowel is referred at one time to O and at another to *awe*, and if an Italian speaks English with it, the word *bold* seems to be *bald*, and *bald* seems *bold*. It is long in 'póco,' little; pórtō, port; spóso, husband; and short in tróppo, too much; nóttĕ, night; cósă, thing. Mr. Ellis's key words are rōco (hoarse,) and rŏcco (crozier,) and he refers to this sound, Swedish *a*° and Danish *aa;* and with doubt the French vowel of *hotte, homme*, with which we do not agree. Mr. Ellis's character is a good one, a Q form with the tail on the left—which might *end with a dot* when the vowel is short. Dr. Comstock uses O with a minute vertical tail below, for the short vowel of Fr. bonne (good,) Ital. dotto (learned;) and he places the vowel of *own* in the French trône (throne,) and Italian dolce (sweet,) the latter being "*o chiuso*" of the Italian grammarians. An Italian grammarian compares the "*o aperto*" to the French *o* in hotte—"l' O aperto detto da Francèsi *aigu* o *bref*, ha il suono dell 'O aperto toscano, come *hotte* (o-t.)"

O, French *o*.

412. *This sound seems* to the writer to be more open than *owe*, and closer than *o* aperto, and his impression is that the long and short sound have the same quality.* Gouraud

* The Author's French pronunciation was acquired from heterogeneous sources, chiefly English and German, and although he has occasionally revised it in casual intercourse with Frenchmen, early habits are continually crossing later opinions. His practice is to pronounce ô as *owe*, bŏnne as English *bone* shortened, and mŏn with the same nasalised. His ideas of Spanish pronunciation were derived from a South American, whilst his English is partly provincial. On the other hand, his ear is good enough to enable him to tune a piano, (except in the low bass notes,) and to distinguish across a room whether a speaker of German uses the German *w* or English *v*, *provided* the voice is familiar.

cites three kinds of French *o*, referring that of poste, note, code, to *o* in *not;* sort, mort, corde, to Eng. *nor;* and côte, faute, beau, to Eng. *note.*

413. *Bolmar admits two,* the *o* of Eng. *opera* in opêra, homme, loge, remords, offense, comme, notre; and *o* of *over,* in auteur, ôter, impôt, zero, faute, rose. Value admits two, as in Eng. *no, nor;* and Pantoléon two, the first (without English equivalent,) in bonne, homme, trop, au, porter, octobre; the second (in Eng. *old,*) as in trône, eau, beau, matelot.

414. *Picot admits two,* the first "close, that of *o* in *trop,* nearly that of *o* in *nor;*" and "open, that of *ô* in *tôt,* nearly that of *o* in *over.*" Chesnier admits two, as in homme, autel; and Olivier two, as in mobile, cor; and in beau, dos. In this treatise o (formed from Q) will be used *provisionally* for the short sound, and O for the long one.

415. *The New England* or Yankee *o* in whŏle, cŏat, is a short sound with a wider aperture of jaw than *owe,* but not (perhaps) of lip. It has been casually heard, but not studied, and we refer it to the French *o* in *bonne.* Mr. Graham uses o for it.

O, English, in *bōne bŏat.*

416. *This well known sound is long* in moan, loan, owe, go, low, foe, coal, cone, bore, roar, bowl, soul; and *short* in over, obey, open, ŏpinion, onyx, ŏnerous, oak, ochre, rogue, oats, opium; and medial in going, showy. It does not occur in Italian.

417. O *is long in the German* ton, dom, hof, hoch, lob, tod, trog, mohn, lohn, moor, mond; *medial* in oder, also, vor, von, wo, ob, oheim; and *short* in wŏhìn, hŏfnung, ost, ofen, ober, koch, loch, zŏ-o-lōg. Hale, Ellis, Hart, Masquerier, &c., use O; Pitman and Graham ȯ with the tail on the right; Longley and Parkhurst a closed *ω*; and Comstock *Ω, ω.* Kneeland uses ȯ as in *know, holy,* and o for its short quantity in *home, wholly*—having probably the New England vowel in view.

Ọ, Italian "*o chiuso.*"

418. *For this sound* we will use *ω* provisionally—but preferring the closed form of Mr. Pitman. It occurs in cónca (cὼſca) a shell; ōndă, wave; bótte, a cask, (but bótte a blow is open;) no-ió-so vexatious. It is long in ancóra (ăſcὼră) yet, and short in áncora (áſcωra) anchor, Ottóbre (ωttώbrĕ) October. As the sound is an O approaching to U, it is probably the one which those have in view who assert that in some words, as *Roma,* the Italians place U. Mr. Ellis formerly used ọ for it, but latterly a closed *ω.*

419. *As in dialects of Latin,* some wanted O and some U, one being used for the other, it is hardly possible that Latin O was *o aperto.* If known to Latin, it must have been *o chiuso,* but more probably the universal O.

V.

420. *Sjögren uses this character** for the most evanescent and obscure of all the vowels

* Ossetische Sprachlehre. 1844, p. 17—19.

he has to treat of; a vowel which seemed at times an evanescent *e*, or an *i*, or even a German *ö* or *ü*, or a Russian ы, or something between these.

ω?

421. *The same author* uses *ω* for a sound between O and U. He cites French *moi*, Swedish and Danish *sol*, and German *gross*, *noth*, *oben*, but these latter are English, as in gross, note, over. He has probably *o chiuso* in view. Castrén (p. 7, § 11,) mentions an open Ostjak *u* which approaches *o*, as in *ud* or *od*, the hand. We have heard such a sound in the Iroquoi word for *ten*—Ů˘JE˘LI˘; and it may occur in the Irish (of Munster) mʊ hù *my eye;* cùıdj *five.**

U in *pool;* U in *pull*, (ɯ, ɯ, u, u.)

422. *These two vowels are distinct* in quality, and have the same variations in quantity. They are to each other as *awe* is to *odd*, and they require distinct characters. These, in the ordinary alphabet, may be u, ʊ, with marks of quantity.

423. *In passing through the series* A, O, U, it will be found that U in *pool* is labial in its character, and that this labiality is preserved in shortening *foo˘l* to *foo˘lish*, whilst *full*, *fullish* have very little aid from the lips. We may represent *fool foolish* (often a medial,) by fūl, fŭlıf.

424. *If we compare fool* with a word like *fuel*, *rule*, (avoiding the Belgian diphthong *iew*,) we detect in it (fyoo'l, rule,) a closer sound, which, when long, is confused with U, as in *fool*, *rule*, meaning by the latter neither ryule nor riwl, but *rool*, with a narrow aperture. This closer ʊ is often preceded by *y* and *r*, as in *due* (=djʊ˘,) dew, stew, rŭin, rūde, where it is rather medial than long.

425. *The Latin* u *is long* in woo, two, too, tour, poor, do, who, move, prove, groove, lose, soothe, boom, tomb, moon; and perhaps brew, crew, threw, true, if these are not the closer U lengthened. U is *medial* in boot, shoot, root, troop, (all of which Walker marks long, like move,) goose, loose, moos, droop, stoop, hoof, proof, tooth. U is *short* in ġood, wood, hook, which is not *who* with *k* added, as Walker would have it.

426. U is *short* in foot, full, pull, could, (and if the same aperture is preserved, these do not lengthen into *pool*, *coo'd*.) In the following, *y* precedes the short vowel,—acute, dispute, refute, refutation. U is *medial* in rude, truth, fruit, brute, and *long* in fume (fjʊ˘m,) amuse, refuse, bruise.

427. *The vowel of fool* occurs *long* in the Italian piu (pjū;) Sătūrnŏ, Mercūrio; tū, thou; in the German pfuhl, uhr, fuhr, buch, and *medial* in urtheil, nur. That of *foot* occurs

* We have heard an Irish vowel in loch *lake*, (sometimes lʊχ,) which seemed to lie between *up* and *ope*, but the *o* without labiality. We merely call attention to it here, and to Tschudi's work—Die kechua-Sprache, (Vienna, 1853,) which contains details of pronunciation, but which we have not now within reach.

short in Italian púnto, point; and in German nusz, nutz, muster, stumm, stunde. The French *ou* (in *pool*) is long in foule, and short in courrier.

428. *For the vowel pair of pool, pull,* Lepsius, Max Müller, Ellis, Rapp, Eichhoff, Bopp, Hale, Hart, &c., use u; Comstock, a character based on ʊ, and ʊ, (perverting u to *up*;) Pitman (formerly) and Graham ɯ, u; and Bishop Wilkins ʊ.

429. *There are two objections* to ɯ, *ɯ*,—it ignores 'u' as made for a full open sound (note, § 359,) and it obscures writing and italics as in *mun* (moon) for *mun*. This use of *ɯ* in Russian, for English *sh*, is inconvenient, as in writing "*ɯɯɯka*," a pine cone.

ʁ

430. *There is a middle series* of vowels between those of the throat and the lip side of the scale, and akin to both. Between the *o* of *obey* (as being closer than *owe*, and *ɛ* of *ebb*,) we place the close French *eu* in eux, lieu. It is marked ö in § 369.

ʁ

431. *The open sound of the preceding* is heard in the French oeū, beūrre, neŭf; of which some consider *de, me, le* the short quantity. Both this and the preceding are made with the jaw cavity large, and the lips pursed. Pantoléon writes but one French *eu*, making no difference for quality or quantity, in which he is not alone.

432. *German has an allied* or identic sound, long in schwören, schön, könig; and short in möchte, wörter, löschen. To the writer, there seems but one German ö, that of French *neuf*, with a tendency to the *e* side of the scale. *a*. But Lepsius refers könig to the closer of the two French sounds, and the word Gö-the to a position between this and the more open sound of French *beurre*. If this sound exists, there will be three allied characters wanting, ʁ for beurre, (being an open character for an open aperture;) ʁ for Göthe; and ʁ for könig (a close character for a close aperture,) the letter to be unmutilated (ʁ) when the varieties are not discriminated.

433. *The first or most open* of these could be written on a *u* basis, with the break of the left side towards the left. Dr. Lepsius writes the vowel of könig (ǫ̈,) with the mark of length above, when long; that of Göthe (ǫ̈, and of beurre (ǫ̈) with a line of length when long, and if this sound were to occur nasal and accented, its letter, the doctor's notation, would be ǫ̈̃.

434. *Rapp* writes the closer sound* ö̂ as in peūr, leūr, seŭl, oĕil; and the open one ö̈, as in je, de, se, le; and ə (of English *but*, the article *a*, &c.,) in the French final of *noble*, &c., when pronounced in poetry. Thus for French 'redoutable' he writes *rödutáblə*.

* Physiològie der Sprache, Vol. III., 1840, p. 108.

Y, y, *y*, (*Υ*, *υ*,) Gr.; Dan., Swed., Y.

435. *If there is any difference* between French *u* and German ü, it is that the latter has a tendency towards I. It is long in the French buse, vue, mûr (ripe,) and short in mur (a wall,) vu, une, fut. It is long in German übel, güte, natürlich; and short in glück, küche, küssen. We are unable to give an opinion whether the Danish and Swedish *y*, and Belgian *u* are exactly identic with the French sound.

436. *The historic character* is Y, often used in Greek typography. Max Müller uses ü; Lepsius the same, with the dots below; and Comstock *Υ*.

ü

437. *Dr. Rapp uses this* character (4, 114,) for a vowel between ö and ü, occurring in the German of Elsess (Alsace,) and unknown to us.

u̥,?

438. *This letter is used* by Castrén (§ 11,) for a "close *u*" in Samojedic dialects.

ᵘ.

439. *Welsh u* (*y*,) long and short, a distinct vowel according to Ellis, and made "with the tongue between the teeth."

ɥ.

440. *The Swedish u* is pinched, and is between *ə* and *it*. Castrén mentions it as an Ostjac sound. In the ordinary alphabet, ɥ is at hand for it, as in Islandic Gɥ˘d, God. *a*. Mr. Pitman has a reversed *u*, a tailed *w*, and several other forms of these letters, which could be distributed as required, among the vowels of §§ 437–40. See §§ 409–22.

441. *The following table* (§ 444) is compiled from Rapp (2, 119, 140, 150, 152, 171, 180;—3, 161, 223, 265, 308, 312;—4, 7, 111, 115, 118, 119, 127, 130, 134, 144,) and is in his notation, the circumflex indicating length and not quality; ê being the vowel of *they*, and ä of *there*. His key word for the fifth column is '*broad*,' which does not suit English, the vowel being *awe* and not *o;* but as it suits other vowels, it is not altered.

442. *This table shows the absurdity* of what is falsely called etymologic orthography, and the impossibility of giving the history of a word in any single spelling. It shows that a phonetic representation of the various phases constitutes the etymology and distinguishes the newer from the older forms, and that in using the present alphabet, LIF, and JIR, are the only proper representatives of *leaf* and *year;* and farther, it shows that the vowel of *vein* has no more right to an *a*-character than *o* or *i* have, for if the original A became E in Gothic, it equally became *awe* and *o* in other dialects.

443. *Eichhoff's table of mutation* (Parallèle des Langues, p. 91,) shows a similar result, the short Sanscrit A being represented by A, E, I, O, U, in Greek, Latin, Gothic, German, Lithuanian, Russian, and Cᵏeltic.

444. SCHEME OF INTERMUTATION.

	house,	good,	leaf,	year,	broad,	thief,	wide.
Original,	*û*	*ô*	*å*	*â*	*ä*	*ê*	*î*
Gothic,	"	"	"	*ê*	"	*iu*	"
Islandic,	"	"	*ou*	*å*	*ei*	"	"
Anglish,	"	"	*ea*	*ä*	*å*	*éo*	"
Friesian,	"	"	*å*	"	*ê*	*ia*	"
Old Saxon,	"	"	"	*â*	*ä*	*iu*	"
New Saxon,	"	"	*ô*	*å*	*ê*	*ê*	"
Old Suabian,	"	*uo*	*ou*	*â*	*ei*	*ie*	"
English,	*ou*	*û*	*î*	*î*	*ô*	*î*	*ei*
Danish,	*û*	*ô*	*ô*	*å*	*ê*	*û*	*î*
Swedish,	*ü̈ü̈*	*û*	"	*ô*	"	*jü̈*	"
Belgian,	*ö̈ü̈*	"	*ô*	*â*	"	*î*	*ai*
Low Saxon,	*əu*	"	"	"	"	"	*əi*
Upper Saxon,	*au, əu*	"	"	*å*	"	"	*ai, əi*
Old Upper Ger.,	*û*	*uo*	*ou*	*â*	*ei*	*ie*	*î*
Old Lower Ger.,	"	*ô*	*ô*	"	*ê*	*ê*	"
German,	*au*	*û*	*au*	"	*ai*	*î*	*ai*
Alsace,	*ü̈ü̈*	*ü*	*eao*	*å*	"	*iə*	*î, əi*
Suabian,	*əu*	*uə*	*au*	"	*ò i*	"	*əi*
id. dialect,	"	*û*	"	*â*	*ai*	*î*	"
W. Frankish,	*au*	"	*â*	*ô*	*ä*	"	*ai*
E. Frankish,	"	*əu*	"	*əu*	*â*	*əi*	"
Bavarian,	"	*uə*	*ä*	*å*	*òə*	*iə*	"
Swiss,	"	"	*â, au*	"	*â, ai*	"	*i, əi*

INDEPENDENT VOWELS.

445. *In using the blowpipe* to direct the flame of a lamp upon a small object, as in testing minerals, or in goldsmiths' work, a continuous blast is kept up by filling the cheeks with air, without interrupting the natural breathing through the nostrils; that is, the air may pass into the nostrils, and out of the lips, simultaneously. To effect this, the base of the tongue must close the back of the mouth in the *ng* position.

446. *With the back of the mouth closed* in this manner, or by a deeper closure, the air within the mouth is entirely cut off from that in the lungs; yet it may be compressed and forced out from behind a *p, t, cay,* position, or dilated by a sucking action behind a

d, t, tl, c, cl, position, and caused to produce a sound by the opening of the consonant contact, not with voice or breath, but by a resonance which some may consider an 'independent' aspiration.

447. *If an inverted aspirate sign* is prefixed for inspiration or suction, p̩e will indicate a syllable drawn inwards. Let ↓ indicate independence from the lungs, of the vowel effect or resonance, before the character of which it is placed, when p↓̩ə will indicate the sound made faintly by smokers when separating the lips under suction;—t↓̩ə̩, one of the Hottentot clacks, the inverted accentual indicating force;—t↓̩l̩ (or with *k*-,) a sound made to start horses;—̩h̩ a nasal trilled or vibrant inspiration, or *snore;*—p↓ə (the air expelled,) a sound described to us, probably Dacota, for in Riggs' Dictionary, *p* (also t, k, c′=*tsh*,) with a dot below "has a click sound," whence the word for *elm* is probably p↓̣əe (or p↓̣e, if the effect is deemed aspirate.)

448. *In the Nadàco* (an English name, An-a-dah-has of Schoolcraft,) a Texan language, we have heard such a sound following *t*, with an effect as loud as spitting, and somewhat resembling it, as in căbát↓ə̩ (thread,) where the resonance is modified by an *o* cavity;—nu′st↓ə̩ (paper;)—t↓ə̩á˘u˘h (tooth,) with final h, it may be considered a dissyllable;—há·vt↓ə̩ (wind;)—q↓əàs (thigh,) a monosyllable, the vowel of medial length. There is an English click sometimes heard, indicative of impatience. It is a rapid repetition of t↓̩ə.*

CHAPTER XV.

THE CONSONANTS.

No condition is more necessary for the success of a projected system of orthography than that it should be as much as possible a necessary deduction from fixed principles, and as little as possible a matter of arbitrary invention. . . . Now, the arbitrary elements of a reformed orthography should be as few as possible; since, as long as they are arbitrary, they will vary with the peculiar views of the innovator—and as one innovator will rarely give up his own details for those of another, there is no means of insuring uniformity except by laying down preliminary common principles, and admitting some common principle of reasoning upon them.—*Prof. Latham,* Feb. 1849.

449. *The nature of the consonants* having been described in Chapter 8, it remains to give them in detail; and in adopting the Roman alphabet we may associate each sound with the character made for it, or indicate certain known sounds in the same manner that one without a letter would be indicated analogically. Premising that *ph, th,* cannot be used for simple sounds, because they must have their power in *uphold* and *pothook,* we may in-

* *Dh* is a sound peculiar to the Galla language—and extremely difficult to be acquired, the *d* being followed by a sort of hiatus, or guttural approaching to the Arabic *ain.*—*Ch. T. Beke,* Esq. Proceed. Philol. Soc. 1845, vol. 2, p. 89.

dicate an aspirate of G by ʿG, and of *cay* by Greek χ, causing a discrepancy which the use of ʿc (with the aspirate mark above) would obviate.

450. Sjögren uses an h formed by continuing the termination down and towards the left, nearly in the shape of ɔ, and this ɔ is added to aspirate any lenis phase. Thus, using the Russian alphabet, Г is *gay*, and the ɔ mark added makes it a sonant aspirate;—added to П it forms *ph*, and to the stem of *T*, *th*, but the last is not correct, because *t* and *th* (θ) belong to different contacts. The lower projection of *K* similarly curved gives χ. This mark forms part of the character, so that there is no economy of types, as there would be in using the Greek asper mark. *a. This and the allied marks,* when convenient to the printer, or when types are specially made, should be placed over the letter.

LABIAL CONSONANTS.

§ 451.	p	ʿp (φ)		m̆	v̆	..	..	..	p̃, *surd.*
	b	ʿB (w ɛ)		m	v	v_c	ʿv	ʿv_c	B̃, *sonant.*
	1	3		5	7				12
	2	4		6	8	9	10	11	13

Of these, p, b, m, have their English power; ʿp is preferred to Greek φ (§119) except in script; and its sonant form ʿb to its proper letter (W, § 127) in the Roman alphabet, or to the Romanic ɛ with which (or with a *b* with the stem broken towards the left) it may be written. This ɛ is to have the centre open, as distinguished from true β, which might be used in the modern language instead of μπ. Böhtlingk assigns both f and φ to Ossetian, Grusinian, and Armenian. ʿB occurs in Ellenic ɛ (sometimes υ,) in Spanish *b* between vowels, and in German (W,) but some Germans use English *v* for it; German *v* and *f* being the same letter.

452. b̃, p̃, are for the labial trill—a rapid alternation between b ʿb, or p ʿp. The *flat* **p, t, c,** have been mentioned in §§ 181, 362–3.

453. *We cannot hesitate* (§ 43) to restore to Latin and Anglish V its proper power (§§ 106, 112, 143–4,) unless we doubt the ancient and modern identity* between QVALE &c., and Italian *quale*, (*quattro, quantità;*) QVANDO, AQVA, and Spanish *cuando, agua*, Italian *quando, acqua;* VIDUA and Anglish *vidva*, and the initial of *widow*.

454. *The Latin* 'V' *consonant* is in the predicament of English '*w*,' most scholars know the latter through its German power, and some of them cannot permit themselves to believe that it is almost a vowel. We consequently find English and German '*w*' confounded, (as in the alphabets of Matushik and Sᵛuñic′,) precisely as the English confound their '*v*'

* This identity is denied in the Roman Orthoepy of Prof. J. F. Richardson, who turns QVANDO into *cando*, and would reject the tables in § 223. His table of the consonants (p. 51,) is erroneous—he gives no authority for Z being *ds*— and he is silent in regard to *m* final and *n* adulterinum.

with Latin 'V;' although, in each case, there is ample material for determining their nature.

455. *In assigning* 'V' *to its proper power*, we are giving a great advantage to English over many other languages, where the sound has swerved into a sonant *f;* and in doing so we follow Eichhoff, who assigns the proper power to Latin 'V' and uses it for Sanscrit, as in Vǎst, Latin Vasto, Eng. > waste (=VEST') to destroy; Sanscrit Vĭd to discern; Latin Vĭdĕo to perceive; English *wit* and *e-vid-ent*, where *wit, -vid-* are false spellings, *wit* having the right sound and the wrong letter, whilst the variation of sound in *-vid-* has not been accompanied by a change in spelling, according to Dr. Latham's sixth rule—"That changes of speech be followed by corresponding changes of spelling."

456. *Latin* V *has a surd aspirate* in English *wh*, which is always followed by V *way*, as in *when* =ʷvɛn, which is not ᵛvɛn, as some suppose, nor is it *hwen*, as *hden* is not *then*. A character commencing with (ʿ) would be suitable for print; and for script, a *v* with a break towards the left, in the descending stem. Unfortunately, this sound is departing. We heard *wig* for *whig*, the first time in July, 1848, and not unfrequently since. When this confusion is established between when wen; where were; which witch; wet whet; whey way; wheel weal; the language will have ceased to be a refined one.* The sound probably belongs to Welsh, provincial Danish, and ancient Greek.

457. ᵛV *occurs* in several Vesperian languages, and the whistle which Duponceau attributes to the lɛnàpɛ (Delaware) language, is this sound, as in ᵛvtē (heart, ndē, my heart,) ᵛvtèhīm (strawberries,†) with flat t. In the Wyandot (vd̆ndȯt,) salăc̆vu̯ (it burrows,) it occurs before a whispered vowel. Compare Penobscot nɛ̆cᵛvdɐ̆ˊs (six; ᵛvtàu·ăc (ear;) ᵛvtàuăgŏlᵛl (ears.)

458. V꜀ *a nasal English w*, occurs in the Penobscot word for *seven*,—tɐ̆mbà꜀·v꜀ɐ̆s. It is No. 1 of the Scheme, § 193. The labial coalescent (§ 451, No. 11,) is nasal in Wyandot, as in

nɛ́ ▸ ɛtă ▸ʿ	ăŭ'rvɛ꜀h꜀á꜀v꜀	tsĭ ▸ ĭgvăvó꜀t.
the pine	*all winter*	*is green.*

LABIO-DENTALS.

F, f; Ɛ, ɛ, (v,) English *v*.

459. *Sounds formed by the contact* of the lower lip and upper teeth, of which F is the

* "Not necessarily. . . . . In the south of England so few people say *when, whig*, that *this* is the harsh and unrefined, the provincial pronunciation. . . . . The sound *wh* is a dialectic pronunciation of *khw* in Welsh; and, indeed, it would appear that *wh* in English came from *khw* through *kw*."—*Ellis* MS. *note.*

† A heart-shaped fruit, but in Wyandot they are called stars, from their bright appearance among the foliage.

best known. The *v* of English, French, Spanish, &c., not being a Sanscrit, Greek, Latin, or normal German sound, it was not supplied with a character in the Latin alphabet. Being a cognate of F, we assign Ɛ to it, of which the written form is *v* with a break towards the right, in the middle of the descending stem. The form may be seen at Rome on the tomb of Caius Poblicus Bibulus, in the abbreviation ·P Ɛ·.

460. *The letter* v (and *v̇*, found in some printing offices,) is *not* recommended, because it is scarcely distinct enough, and it does not differ sufficiently from Latin V, whilst our pair associates well with p, b, &c. (§ 70,) and if English *v* has an affinity with Latin V *way*, as in VALEO, *v*alid, *w*ell; VULGUS, *πόλχος*, *v*ulgar, *f*olk, it has even more with *b* and *f*, (§ 267) as in pro*b*ate, proo*f*, pro*v*e; s-cri*b*e, s-cra*p*e, gra*v*e, gra*f*t, gra*ph*-ic; ro*b*, berea*v*e, bere*f*t.

461. *Should labio-dental* p, b, m, *occur*, they can be formed out of these characters with the aid of the marks in §193. Most authors of ethnic or new alphabets use *v*, and many use *w* with their English power, the earlier ones having done so thoughtlessly, and the later ones to preserve uniformity—although uniformity from a false basis is not desirable. Mr. Ellis's recommendation of 'w' with its German power, and ɯ for English *w*, are the least objectionable—but he uses *v* with its English power.

462. *There is no certainty* in the accounts we have of English *v* and German *w* occurring in exotic languages, for when either is mentioned, we have no proof that the observer knew the difference. For example, although the modern Greeks asserted in the most unqualified manner the identity of their *ϵ* with English *v*, they were in error, and it has been but a few years since this question was settled. In a similar manner, the Spanish grammarians are still mystified about their *b* and *v*.

463. *The sonant labial trill* is used in Germany to stop horses, and we have known a child who emphasised the word *push* by trilling the *p* when desirous of being pushed to the table after having climbed into his chair.

LINGUI-DENTALS.

ʅ, ʔ, (*θ*, *ϑ*,) in *th*in. ɑ, in *th*en.

464. *These sounds are produced* by placing the point of the tongue between the teeth, and they are aspirate in their nature. *θ*, *θ*, *ϑ*, is the Greek character for the surd phase, and *ɗ*, *δ*, the *modern* Greek sonant. They occur in Albanian, as in ɑɛm (a tooth;) ʔɛm (I will say—exactly English *thum*';) mɔʔon (to say,) mɛʔɔn in some dialects; mɛ- being the infinitive sign, as in mɛbó, (to make,) mɛrcúɛ (to go,) mɛdártŭnɛ (to love,) dartùɛr, (lover.) Should a liquid occur, it will be a kind of *l* (ɹ.)

465. *They cannot be represented* by ʿt, ʿd, because they are not formed on a *t* basis.

§56. 't means an aspirate made at the *t* point, behind the teeth, and indicates a sound between *th* and *s*.

466. *Throughout this essay* the lips are supposed to be towards the *left,* and the throat towards the *right.* The characters ɪ, D, (ɹ,) therefore, are supposed to be turned towards the lips.

467. The surd sound is attributed to Spanish *z,* and to *c* before *i, e;* and the sonant to *d* between vowels, as in *saludado;* but the sounds are not quite those of Greek and English. The Anglish and old Nordish character for the surd sound is þ and for the sonant ȣ, both of which are freely used in illustration by the German philologists, as Grimm and Rapp. *a.* T, D, *if made between the teeth,* would be 'ɪ ('θ,) 'ɑ deprived of aspiration.

468. *The fourth Arabic letter* has the power of ϑ (Volney, Ellis, S'uñic',) and the ninth that of ɑ, both as heard by us, but they are changed in different dialects; and in Algerian they are confounded with *t, d* (Paulmier.) Volney's notation is respectively θ and a kind of ʒ; Richardson uses ṣ, ẓ; S'uñic', ṭ, ḍ; Max Müller, th̲, dh̲; Lepsius, θ, θ'; Ellis, a pair of peculiar characters; Comstock, ϑ, δ; Pitman and Graham, a well-formed pair, based upon t, d, with which they harmonise, and which should be adopted. We prefer ϑ to θ, as a script form. Our characters are adapted to the common alphabet, and the Greek furnishes ɿ.

469. DENTALS.

t	-	l̃	-	-	-	ñ	-	*surd.*
d	l	l̃	l̩	⊢	n	ñ	l̩	*sonant.*
1		4				9		
2	3	5	6	7	8	10	11	

469*a.* T, D, L, N, *are formed* by a light contact of the tip of the tongue at or near the base of the upper teeth. The Spanish *t, d,* are said to differ in quality by having the tongue laid against the upper teeth, thus removing the contact towards the lips.

470. T, D, *have no aspirate* forms, (unless *s, z* are so considered,) but we can force breath past the *t* position, and thus form ('ɿ) a kind of *s* or ϑ, just as we can deprive *s* of aspiration and make it ('*s*) a kind of posterior *t.*

471. *Marks are required* for consonants made nearer the lips and throat, and to be placed below or (less properly) after the letter. Let the Hebrew point (ɿ) represent the normal position of a consonant, then (ɿ) the horizontal line directed towards the lips, or (ɿ) throat, will mark the distinction when required. §466.

472. The *t, d,* in *tsh, dzh,* are thus drawn back by the following palatal, and in fact,

they may be considered the lenis forms of *s, z;* and *if they are such,* then tʳf for *tsh* is less philosophic than 'sʳ, which, however, interferes with our ordinary habits of notation.

473. *Those who would write this tsh* with one character, have not provided for cases where the *t* may be adapted to the *sh* of another word (Rule 4, §59,) as in—a*t sh*ore; or where an antecedent *t, d,* may keep the *t* of *tsh* from sliding back, as in—tha*t ch*ild,—ba*d ch*oice, or the reversal of *tsh* in hu*sh't,* wat*ch't,* whatever this final *t* may be.

474. L̊ *is the surd Welsh aspirate* 'll,' which we think occurs sonant in Irish, where it is considered to be a kind of *d.* We have heard the Welsh *ll* in Creek, Choctaw, and Cherokee.

475. *The following are examples* from the musical Creek (an English name,) more correctly—măscòcɪ (*c* as *k,*) in which the name of the "large river," Withlacoochee, and "figured rock river" Chattahoochee, are respectively—

ʊ˘j˝llăcʊ'tsɪ, tsʊ˘tʊ˘hʊ'tsɪ˘;

the former from ʊ'jvă (water,) and l̊lăcĭ (large,) l̊lăcɪmáhĭ (larger,) l̊lăcɪ'ă (largest.) All the vowels are short, and dotted j is the guttural coalescent.

476. *We are doubtful* whether the French *l, r,* of *simple, maitre,* are whispered (sɪ̭ p˘l, m ɛ̣ t r̆,) or surd aspirate, but we incline to the former. Most French orthoepists do not mention this phase.

477. *Castrén uses* an 'l' character with the appendage of 'r' for an intermediate sound in Samojedic, which has more of the (smooth?) *r* than *l,* although both are heard simultaneously. In the absence of the proper type, it may be represented by a mutilated 'h,' as in fe'r'e (half.)

478. *The Polish l* is indicated by 'l' with a line through it in the direction of the acute accentual. We judge that it belongs to the Arabic linguals, and mark it (l̩) with a descending semicircle, cut from a comma point, or from an inverted (ₒ) degree mark.

479. *There is in Sanscrit* a kind of *l* which is regarded as a (long and short) vowel, and if we touch the palate lightly and try to pronounce A, there is so little interruption that the sound seems a vowel until the removal of the tongue (the vocality continuing) exhibits the *l* quality.

480. *The* L *is less interrupted* with open vowels, as in Latin āla (a wing,) than with close ones, as in *eely,* and the two can be discriminated when detached. The Sanscrit sound may have been still less interrupted, as if we were to pronounce *ell* without bringing the tongue in contact.

481. *Eichhoff figures* the Sanscrit letter by ʌ̣L (with a similarly formed R, also used in astronomic typography for *right ascension,*) but with the small letters he follows Bopp in placing *a dot below.* Ellis uses 'l, and Lepsius *l* with a circle below, which we adopt.

482. *Max Müller refers this Sanscrit* vowel *'l* to *l* in *friendly* (and Eichhoff says the *'r* is common in English, meaning probably the smooth *r* in *far*.) But the *-ly* in *friendly* is the *li-* of *live* (transposed in *ill*,) it is the *-ley* of *medley*, and if this word is pronounced with the final vowel suppressed, no ear can distinguish the then final *l* from that of meddle (=mɛdl,) or the *l* in *bulb* from that of the transposed *bubl*, the difference between *medley* and medl̆y being in the diaeresised vowel, (§ 169.) And the question may be asked—If the four English sonants 'mɛdl' do not spell *meddle*, what *do* they spell?

483. Ñ *surd afflate* (§ 195, 469[9],) we have heard in Cherokee (§ 624[10],) and a forcible sonant form (§ 469[10],) in Albanian, as in the word hūñ (*nose*), of which it may be a metathesis.

INDISTINCTNESS.

484. *A dot below a letter* should not be used for any important phase of speech, for as the least mark, it should indicate the slightest sound, whether vowel or consonant. The Abbé Proyart, in his History of Loango, 1776, says of the language—"There are many words which begin with *m*, *n*, as in mFouka, nGoio, but these letters are pronounced so slightly, that they who are strangers to the language would pronounce after them Fouka, Goio." "Some Dakotas, in some instances, introduce a slight *b* sound before *m*, and also a *d* sound before *n*." (These are examples of eduction.) "The letter *n* is hardly heard, and often not at all in the pronunciation of *manji*, [Fr. *j*,] in all the words that begin with it."—*Baraga*, Otchipwe Dictionary, p. 216.

485. *We have heard* this *n* in Wyandot, (= vð´ndð̆t,) where the speaker denied its existence, and would not have written it, had the language been a written one. It occurs in ṇdð'cc (ndðχc, four,) and in the name of the town sca·ṇdɛ́htɐ̆tı' (beyond the pines,) Skenectady in New York—spelt *schenectady*, the *sch* being due to the Dutch. The *h* is the ordinary one, and a slight aspirate closes the word. The accent and the last three vowels are traditionally correct, to remain so until some phonetician fancies that the third syllable should have the vowel of *fat*, as *malady* is supposed to have the vowel of the first syllable repeated in the second.

486. A slight *n* (not *ng*) occurs before *gay* in the Wyandot—

ūṇgĭrá ᴾ	ĭhɐ'r	da·nJ‹o‹'J‹ɛ́ᴾ'.
[3] *nuts*	[2] *he-eats*	[1] *the-bear.*

nJ‹o‹'J‹ɛ́ᴾ' *bear;* (in Cherokee, JΩnɐ‹'.) Here medial quantity is marked with (·). The *r* is smooth, and ᴾ (§ 568) is the Arabic *hamza*.

ARABIC LINGUALS.

487. *Of the Arabic linguals* Lepsius says—"In their formation, the breadth of the tongue

either touches or approaches the whole anterior space of the hard palate as far as the teeth, its *tip being turned below.*" We have heard and pronounced these sounds casually, but *not* with the tip of the tongue turned down. Ellis (Essentials, p. 54,) says—"The tip of the tongue being brought *against the back of the upper gums* tightly, forms ṭ, and loosely, forms ḍ."* Here we think that the only difference between the *t* and *d* is the sonancy of the latter.

488. *The Arabic letters* of this phase are the following, to which we add our marks for lenis and aspirate, sonant and surd. Paulmier's is Algerian, and Volney's characters are cut with peculiar hooks, on the basis here indicated.

	ʼ	ʼ	ʼ	ʼ
Smith & Robinson,	ṭ	ṣ	ḍ	ẓ
Lepsius,	ṯ	ṡ	ḏ	ẓ
Ellis,	T	ſ	D	J
Max Müller,	T	Z	Z	T
Paulmier,	t′	s′	d′	z′
Volney,	t	d	s	ʒ
Richardson,	ṭ	ṣ	z̈	z̈
S^uñic´,	ʼt	ʼs	ʼd	ż

489. *All the Arabic forms* (as ط, *t*,) have in common a (ˌ) vertical curve on the right, which we propose as being suggestive, and as more appropriate than the dot. Lepsius (Alphabet, p. 46,) adds a (theoretic?) *n* to the series, and we are inclined to place the Polish barred *l* here. (§ 478.) This would give the series—

tˌ sˌ dˌ zˌ nˌ lˌ.

490. *The Polish* s´, (and z´) although described as a mouillé *s*, (z,) is perhaps near the 's ad.' Vater (Gramm. Poln. 1807,) describes the Polish sound as between (German) *ssj* and *ssch;* and Bishop Pigneaux uses *x* for a sound between *s* and *sh.*† We have heard such a one in the Waco (= Vèco) of Texas which we will mark provisionally with ɔ, (or if sonant—ɔ̉) as in ɪscvètɔ (five,) a word derived from that for *hand*, as in Lɛnàpɛ and Hebrew. We attribute the same sound to the Chinese of Canton (cvɔ̉ſtŏſ,) where the word for *ten* is ɔɛpʾ.

* "The sound differs very slightly if at all in the two pronunciations. The tongue is certainly not contracted and hard, when the tip is brought forward, but wide and soft. . . . The Polish *l* is to lingual *t*, as *l* is to *t*."—*Ellis MS. note.*

† "Ita littera *x* etsi sola indicat unam consonantem cujus sonus medium tenet inter litteras *s* et *ch* Gallorum et xa, xê, etc. proferunter modo dulciori quam apud Gallos et etiam modo molliori quam *sc* apud Italos."—Dict. Anamitico-Latinum. Serampore, 1838.

SANSCRIT CEREBRALS.

491. *These are thus described* by Wilkins (Gramm. 1808,)—"This series of consonants is produced by turning and applying the tip of the tongue far back against the palate; producing a hollow sound, as if proceeding from the head." Lepsius and Ellis add the common Sanscrit *r* of other authors. Wilkins says that in Bengal the *d* is "pronounced like a very obtuse *r*." See §199. We will assume that the Sanscrit *r* is a common trilled *r*, and that the Bengali sound is a trilled cerebral (not *d* but) *r*, and to be so written. Eichhoff (p. 80) excludes the *l* as fictitious; Wilkins makes it the Welsh *ll*. Eichhoff uses his dotted L for a Birman sound, which others consider Polish *l*.

492.	Lepsius,	*ṭ*	*ḍ*	*ṇ*	*ṣ*	*ẓ*	*ṛ*	*ḷ*	*ṭ̣*	*ḍ̣*
	Ellis,	tc	dc	nc	ſc	ȝc	rc	lc	tcH	dcH
	Müller,	*t*	*d*	*n*	sh		r	*l*	*th*	*dh*
	Bopp,	*ṭ*	*ḍ*	*ṇ*	*ʿs*		*r*		*ṭ̣*	*ḍ̣*
	Eichhoff,	T	D	N	S		R	L	TH	DH

493. *Most of the Sanscrit forms* have a horizontal curve below (◡) by which we propose to denote them, placing it below or after the base letter, as in—

t◡ d◡ n◡ s◡ t◡h d◡h

494. *Another mode* is to use the small italic capitals, *T, D, N, S,* &c.,—and Bengali *R*, which would represent the point of contact as removed towards the throat. §471. In Ellis's notation, 'c' is a diacrit, 'k' being used for the *cay* power.

SIGMALS.

s, ʒ, r, ṙ, ṛ, ꞅ, ꞅ̇, ꞅ̣, ꞅ̣, ꞅ̣.
1 2 3 4 5 6 7 8 9 10

495. The affinity of the aspirates of *s*eize is rather with the dentals than the palatals, with which (§158) they are often classed. Most authors represent them by *s, z*, the latter being a perversion to which we are exceedingly averse. Bopp uses *ζ* for English *dz*, which is also wrong. Although we do not approve of *any* double letters, *z* may be wanted for Russian *zd*, a power which is constantly before us in Greek, and perhaps in Hebrew. (*Ewald.*) Compare ὄζος and Aeolic ὔσδος; Hormuz and Hormuzd; Oromazes or Oromasdes; Ezra-s or Esdra-s. The use of English *z* would tend to destroy the etymologic value of every word (like 'ozone') transliterated with it from Greek, whilst a new character would indicate a new sound ('oʒon') in a corrupted or naturalised form. This objection would be weakened if Greek Z were transliterated with *zd*, but we fear that very few would use forms like *ozdon*, or *horizdon*.

496. The English or French *z* is unrecognised in Greek, Latin, and Spanish, and it

therefore requires a new or modified letter. We at first employed *s* ending in a comma point to simulate C, G, but this degenerated into a character like the Russian form (ʒ) which we adopt, using the numeral 3 until the proper type (a reversed ε,) is cut.

497. *The character* 'z' is hardly known as the sonant of *s* (out of which it has mostly arisen,) except in some of the Slavonic languages, and it is not recognised as the proper character in French, English, Italian, or German. In the two latter it is always expressed by *s*, and in the two former, in the great majority of cases, as in rose, misery, positive. Even in common English, it is disliked, *s* being preferred in words like analyse, criticise, &c., and were it introduced, it would falsify etymology throughout, not excepting words like *zeal* and *horizon.*

498. *Lepsius rejects the Romanic Cay* on account of his third rule, which virtually rejects pronounced and etymologic Latin, and tends to render the barbarisms in it permanent. Yet, if he rejects Cay on account of its many powers, it had at least its *correct* power in several important living languages, whilst z has its correct power in no modern language, and its perversions are quite numerous. *a.* Its powers are, 1. Ancient Greek, as English *zd;* 2. Italian *dz* (and *ts;*) 3. German *ts;* 4. English in *azure;* 5. as *s* in Hungarian and Danish; 6. French; 7. Spanish; 8. Middle high German; 9. Scotch, as in *Dalzel* or *Dalyel,* where it is derived from G through the Anglish ȝ.

499. *Bopp uses* ȘȘ (§484,) for French, Polish, and English *z*, for which 's' and our surd mark might be used, but the space above may be wanted for marks of quantity. Most authors use *z* for it.

500. *The Greek and Latin* R was trilled, as described by the ancients, and this accords with European practice. The letter 'r' therefore means this sound—however convenient the addition of a sign of trill (˜) might be found. Rule 5, §63. *We have heard* trilled *r* in Albanian, Armenian (in part,) Arabic, Chaldee, Ellenic, Illyrian, Wallachian, Hungarian, Russian, Catalonian, Turkish (in part,) Islandic, Hindustanee, Bengalee, Tamil, and other languages, in the pronunciation of natives.

501. *The trilled r* is assigned to English as an initial, although many people with an English vernacular cannot pronounce it. Dr. James Rush would have the trill reduced in English to a single tap of the tongue against the palate. This we indicate by ṙ, with a dot above.

501*a*. *The Spanish* (South American) *r* in pɛrro (dog) as distinguished from the common trilled *r* of pēro (but,) seems to be untrilled, and to have the tongue pressed flatly, somewhat as in English *z*, and doubled, as in *more-rest.* It may have arisen from an attempt to yotacise *r*. We mark it *r* (or if trilled, r,) with a line below, in case it is distinct from the next. §502.

502. *Armenian and Turkish* have a smooth (i. e., an untrilled) tactual *r*, much like the Spanish *rr*, if not the same, and with that, requiring farther investigation and comparison. Our impression is, that this oriental *r* may belong to the series of the Arabic linguals, in which case its letter would be *r*,, as in Turkish (with Latin letters) jīr,mí (twenty-one,) whilst Turkish ʟɛrmɛc (to give) has the ordinary or trilled *r*.

503. *English smooth r*, in curry, acre (a-cr,) begr, grey, curt, is formed by much less contact than the European and Asiatic *r* requires. It is the true liquid of the *s* contact, and allied to the vowel (ɐ) in *up*, a character to be formed provisionally from italic *x*. Ellis writes it ɹ.

504. *The Sanscrit vowel r*, long and short,—written by Lepsius with *r* and a circle below, and 'r by Ellis, should probably be figured on this basis.

505. *A more open, smooth* r, is found in cur, fur, far, more, which may be marked in Ellis's mode, with an r having the stem continued down to the length of '1;'—or with (r) Anglish *s*. We use the latter in our examples.

506. *Mr. Ellis regards* 'fur' as *f* and this open *r*, without a vowel between, and Kneeland had a character for *ur*. We regard *fur* as having the *open* vowel ʊ (with which the consonant is allied,) *short*, the quantity being confined to the consonant (*fur*=fʊ˘r¯,) and the tongue moving from the vowel to the consonant position.

507. *The same open consonant* occurs in arm, worm, turn, ore; and although, for a particular purpose we have cited *arm* as long (§ 93,) it contains a short vowel (a˘r¯m) and long or medial consonant.

508. *If we write* 'rn for *urn*, and f'r, or fʀ, for *fur*, we certainly cannot represent *far*, *four*, in the same manner. Moreover, we may dissyllabise pr-ay on a trilled or a close *r*, and monosyllabise it p'ray with the most open.

509. *At one time* the discussion of the English letters led to a curious result. When the *difference* between the open *r* of *tàrry* (from *tar*) and the close one of the verb *tárry*, was ascertained, an *identity* of vowel and of consonant was represented,—a greater error than to spell *more* and *moor*, *fairy* and *ferry* alike, or *pres-d* for *prest*.

510. *The Welsh surd aspirate* rh (ˆr) may be the smooth element. We do not remember its character upon this point. The French -tre, -pre, is trilled, and perhaps rather whispered than aspirate.

511. *The Polish rz*, Bohemian rˇ, is a trilled (and as we believe) aspirate *r* (sonant and surd) made simultaneously with *zh* (ʒ) or *sh* (ʃ.) See Ellis, Essentials, p. 50. One hypothesis has been given in § 200, another presents itself in the probability that it has arisen from an attempt to yotacise *r*, yotacism being common in the Slavonic languages. § 519.

512. *Lepsius represents* Polish rz by *r*˘, Ellis by 'ɟ' with the appendage or projection of 'r' an excellent character, to which the surd mark (´) might be added when necessary. We propose, for ordinary type ᵃrɟ, ˣrɾ, for sonant and surd, to the latter of which we think Mr. Ellis's key word przez (= pˣrɾɛ ʒ,) belongs, owing to the influence of the surd *p*. If there is no aspiration, its mark must be suppresst.

513. *There is no guttural r*, all the foregoing being made strictly in the anterior part of the mouth. But in dialectic German and French trilled *r* is replaced (by otosis) with a vibrant guttural, which is as far from *r* as German *ch* is from *s*.

PALATALS.

ʃ, in pot*ion*.	ỹ, in nat*y*ur.	tʃ, in *etch*.
ɟ, in braz*ier*.	ɟ, in sold*ier*.	dɟ, in *edge*.

514. *Every consideration*, philosophic and practic, requires that English *sh* (ʃ) and French *j* (ɟ) should have distinct characters, and that these sounds should *not* be considered as having an aspirate or other affinity with *s, z*. § 58. Our characters are as distinct as 'b, d,' and they have not been chosen that they may recall Latin S, J. Moreover, were it necessary to use a pointed '*s*' either for ʃ or *ϑ*, we would prefer it for the latter, as less likely to outrage affinities. The character 'ſ' was proposed by Volney in 1818, 'ɟ' by Ellis in 1856, and both were used by us in 1846.*

515. *The following are some of the forms* which have been proposed for ʃ, ɟ.

Bopp	ś	ź	Ellis	ſ	ɟ
Lepsius	š	ž	Longley	"	ʒ
Sᵛuñic'	sᵛ	zᵛ	Parkhurst	"	"
Riggs	s´	z´	Pitman 1844	ʃ	ɟ
Max Muller	*s*	*z*	" 1856	c	j
Rapp	*sh*	*ſh*	Graham	"	"
Eichhoff 1836	ç	ɟ	Matushik	†	†
Hale 1846	ç	*j*	Masquerier	ˢʰ	ɟ
Comstock 1846	c	j	Pickering	sh	zh

516. *Among the worst of these* and other forms, are those which were intended to recall the erroneous English notation, or to convey the impression, that ſ has some aspirate relation to s, § 58. Still worse is the desecration of Latin Cay.

517. *The Sanscrit* श, according to Wilkins, "is produced by applying the tip of the tongue to the fore part of the palate, and passing the voice as in pronouncing our *s*."

* Proceedings of the American Philosophical Society, Vol. 4, p. 268.

† An S facing the left, and a Z facing the right.

Eichhoff, who took his pronunciation from the mouth of Rammohun Roy, makes it French *ch*, Eng. *sh*, and Max Müller does the same. Bopp makes it different, he marks it 's, the English *sh* sound being assigned to the fourth cerebral of § 491. Lepsius (Alphabet p. 42,) and Ellis, thinks it χ. By the description of Wilkins, it may be a sound between s and ʃ, or a flat s, or one formed a little posterior to the ordinary point of contact. We have been accustomed to use ʃ for it, but as this is unsatisfactory for a doubtful sound. Eichhoff's character ç may be used. χ must have occurred in the antecedents of Sanscrit, although it seems foreign to the genius of Sanscrit itself.

518. *The liquids of the palatal contact* are a kind of J (*yea*) made at the palatal point, and as Eng. *w*, *v*, and *r*, *z*, are permutable, so ʒ falls into ɟ, and its surd aspirate into ʃ.

519. *Hence the word soldier* (=soldʒr, or soldʒər,) is apt to fall into soldɟɤ; and *nature* (=net-ᵊʒɤ, netᵊʒʒɤ, or netʒɤ,) into netʃɤ, or netʃəɤ.

520. *Jotacism* (*yotacism*) is the forming of J or some other allied sound *simultaneously* with a continuous consonant made with the outer part of the tongue, as *s*, *r*, *l*. Let the back part of the tongue be held in contact near the J (*yea*) point, and the apex upon *l*, in forming *li* in *million*, when the effect will be mɪlʲʒən, as the French *fille* is filʒ, or filʲʒ, or (eliding *l*,) fiᵊʒ.

521. ʃ, ɟ, *must be yotacised* with the true ɟ (*yea*,) because an attempt to do so on the ʒ basis, would produce a sound between mute and liquid, like the fusion of English *r*, *z*.

522. *There is probably no true yotacism* (§ 519) after labials (p, b, m,) and gutturals (cay, gay,) or abrupts, for how are pj, gj, (or pʒ, gʒ,) tj, tʒ, to be sounded except in succession? The simultaneous effect, like that cited in *million* (properly mɪʲljən,) is therefore cut off in the Russian pjɛtᵊʒ (five, whilst in sʲʒɛm (seven) it is apparent, with a surd liquid preceding the sonant which meets the vowel.

523. *The palatal liquid* seems to be present in the French *gn*, Spanish ñ, as in cigogne (=siGonʒ,) *niño* (=ninʒo.)

524. *Castrén's notation* of real or supposed yotacism requires numerous types, as he passes a curved line (˘) through the stem of the affected elements, as l, r, n, (the right side,) t, d, s, z, c, (ts.) A small palatal or guttural 'J' (as the case may require,) would be more economical, and might be understood to be surd after surds. Mr. Ellis uses ɟ, a character made by removing the dots of j.

525. GUTTURALS.

[1] c, in *car*.	[2] ḉ, bu*ch*.	[3] ç, i*ch*.	[4] χ̃, Swiss vibrant.
[5] G, in *g*et.	[6] Ġ, betro*g*en.	[7] ɣ, (γ̆) köni*g*e	[8] γ̃, Ellenic id.
[9] ʃG) sin*g*.	[10] ɟ, *y*ou.	[11] ᵊɟ, h*u*e.	[12] ɟ, nasal, § 547.

526. *We adopt* c, ɢ, *instead of* k, g, proposing that a small (lower case) letter be made for ɢ on the model of c. Mr. A. D. Sproat says—"The forms of the Roman and Italian letters (g excepted) are beautiful."* In fact, g is an ugly perversion in which the intended affinity between c, ɢ, is destroyed. The dot of g is that of c, the circle is its body, and its tail is the distinguishing carvilium or mark of sonancy. The French have a lower case form modelled on (*oj*,) the written form, which associates it with its congener, normal ᴊ j. g itself should be curtailed (ɡ) so as not to project below the line.

527. *We adopt Cay Gay* as cognates in power and form, in the chief languages written in the Roman, as distinguished from the Greek alphabet. K is a foreign letter in Italian, Spanish, and French, where *q* is acknowledged—itself preferable to *k*, but *q* is required in its oriental sense.

528. *The use of k would tend* to force it upon Latin, and although this has been done by Rask and Rapp, it is a dangerous course—but a course which shows the necessity of giving Cay its proper power in all cases.

529. *It is true* that 'C' is an S in Greek, but deceptively, the Greek and Russian C being a form of *Σ*, S, whilst Cay is a form of *Γ* which in some cases had a semicircular form in Greek. See Franz, p. 25. Similarly, *x* in *beaux* is a form, not of Latin *x*, but of *s*, as French, Spanish, and English *y* is a form, not of Greek and Danish *y*, but of Latin ij, as is shown in the older typography of Latin, where they are often printed from a single type.

530. *Cay cannot be ignored*, (§43–5,) because it will be always present in etymologic Latin, in Anglish, Welsh, and Irish, Spanish, French, Italian, and old English. Probably every school, and the great majority of reading families, will have an etymologic dictionary, and scholars acquainted with the Latin alphabet, may be inclined to represent the pair, *cay*, *gay*, with the proper letters in exotic languages, where the natives cannot be prejudiced.

531. *If kah is used*, its stem should be shortened, as in Kneeland's character, and as one of its inscriptive forms is lc, this might even be adopted, such a double character being less objectionable than an entire k. The Punic *cay* is C with a vertical line through it, as in ϕ. The Albanian k is a semicircle (ᶜ).

532. *The greatest concession* that could be allowed to *kah*, would be a character made of *k* with the vertical line removed, leaving *c* with a break towards the left, which would be useful in distinguishing script *c* from *e*. But even this would be dangerous, because the

* An Endeavour towards a Universal Alphabet, p. 10. It appears from a notice in the Am. Jour. Sci., 1840, Vol. XXXIX. p. 197, that this author addressed a letter to Prof. Silliman on the subject of his alphabet, dated Feb. 22, 1834, (§30, 79.) It is noticed in the Phon. Jour., Feb. 20, 1855.

rejected *c* would then be at the mercy of every one who might want a new character; so that whilst *c*, *e* would be too much alike with *c* as *cay*, the case would be different with a perverted power. Moreover, *u* and *n* are more alike than *c* and *e*, *v* and *r*, and various examples we have taken from native sources, are worthless on this account.

533. *The Gothic hemi-greek alphabet* has *k*, with which the Germans barbarised their alphabet, especially in the use of the hĭbrid *ck*, but *ck* and *ch* are concessions to the true *cay*, and the use of *k* has not caused *kk* and *kh* to replace *ck* and *ch*. An Englishman will spell 'sceptic' rather than 'skeptic;' an Italian prefers 'chi,' and the Spaniard 'qui' to *ki*, whilst any one desirous of uniformity, who acknowledges 'ca' to be correct, will not object to *ce*, *ci*, if he is provided with the means of spelling tre, tri.

534. *The use of kah for cay* is to be deprecated in a highly latinised language like English. It is equivalent to granting that when words change, the spelling should not change (§455,) but that a new character must be placed in the unchanged words; letting *t* in the French 'nation' have the power of *s*, using *s* for *z*, as in *rose*, and going to Greek for a new *τ* with which to spell words like 'naτif.' This mode is always wrong—that which does not interfere with forms which retain their historic value, is believed to be always right, no matter how long the time during which it has been neglected or broken.*

535. *In old high German* and middle high German, Ça*y* and Kah were both used, and cay quite extensively, so that if the Germans were to re-adopt it, it would be a restoration rather than a novelty.

536. *Etymologic relations.* (§135.) CÆSAR, Ohg. caesar, keisar, cheisar. CASEUS, Ohg. kas, case, chase, Ang. cese, Eng. cheese. CROC-IO, to croak, Ang. circ, Eng. kirk, church.

* Mr. Ellis puts a note here to the effect that English *k*, *y*, *z*, will prevail. "As I deny the effect of *k* for *c* in altering the relations—merely altering them to the eye, not the ear—the argument does not touch me. To mark the connection between English and Latin by the eye *only*, I consider false." This remark is just, and we admit that like letters should represent similar sounds. "If we know *c*=*k*," [and we know and have it as well for English as for Latin] "this is enough, we may then change the Latin; writing (in palaeotype) kaizar? kaisar, keesar, *cæsar;* kaaseus, *caseus;* krookioo, *crocio;* . . . Ang. keeze, *cese*, Eng. tshiiz, *cheese*, &c., where the real comparison is between the phonetic words, and the original spelling (and meaning) is merely added as a means of identification. We must thus alter Sanscrit, Greek, Hebrew,—why not Latin too? I doubt whether we shall ever get people to agree on a pronunciation of Latin, even by introducing such an alphabet as yours. Let us introduce the best we can get people to accept, even though we pay the price of letting Latin be like the rest, a language to be transliterated."

To this we reply, that in transliterating Sanscrit, we do not falsify a single Sanscrit letter, whilst in thus meddling with Latin, the falsifications cannot even have the collateral merits of uniformity and stability—even if we do not take truth to the original into account. No one can yet predict the degree of perfection which people will or may be prepared to accept, but the fact is constantly before us, that the nation which has advanced farthest in civilization, has adopted a metric system in no way connected with the systems already in use, systems which every other nation would probably have determined to be too firmly associated with political organisation and domestic life, to render a reform desirable or possible. Farther, an alphabet displeasing to a European heterotypist, may meet with favor when examined by Cherokees or Chippeways.

Ang. cing, Irish, ceann, Welsh, cûn, Eng. king. CANCER, Ohg. cancur, Eng. canker. CARCER, Ger. kerker, Ohg. carcare, karkari, (prison.) CITHARA, Ohg. citara, Eng. guitar. GENU, Ohg. cneo, chniu, kniu, Ang. cneov, Eng. knee. COQVUS, Ohg. koch, coch, choc; Ang. coc, Eng. cook,=cUc, kUk, kUk.

537. *We rather prefer* G꞉ for the nasal of *sing*, because it tells what the phase is, and we are averse to associating the sound with an n-character, which would be paralleled by representing *d* with a *g* character. It is the English and German *ng* in *sing*,* *finger*,= Eng. fíG꞉Gr, Ger. fíG꞉r, (§20–22.) It is common in Greek and Latin, rare in Italian, and unknown to Russian and normal French; but we have heard it in the Provensal dialect at Marseilles, in Savoy, and in the Bearnais of Pau. It occurs in Spanish, Catalonian, Armenian, and in the Tonga group.

538. *Pitman, Ellis*, &c., use ɥ, ŋ, and Comstock, ŋ, which have the advantage of being like 'J,' the representative of the allied liquid. Others use the same small letter with the end turned towards the right, which is less convenient in print. *We recommend Mr. Pitman's form*, because it may be introduced into Latin (like J for I,) which we dare not do with G꞉. Böhtlingk and Sjögren use H꞉ (a nasalised Russian N,) which is wrong in theory. In the less modern alphabets, *ng* is used. Eichhoff uses ñ; Marsden, *ng* circumflexed; Lepsius, *n* with a dot above, and Max Müller, a capital N. We use ʃ temporarily, because it is accessible in Greek typography.

2. ċ 3. ɢ 4. χ̃, *surd.* §525.
6. G 7. ɢ̣ 8. γ̃, *sonant.*

539. *There are three surd*, and two sonant Germanic aspirates; the first (ɢ) in *ich* is the smoothest and most anterior (§471,) forced forward by the closure required for close vowels;—the second (ċ) in *ach, buch*, the Greek χ, and according to some (but doubtfully) the Spanish j (jota;)—the third, the rough Swiss vibrant aspirate, as in *ich*=ĭəχ̃—a sound we have heard in Lɛnàpɛ. We have also heard the Swiss sound untrilled, as in χántōn, a canton. In the Swiss dialect, it does not vary before *i, e*, and from the slight vowel interposed in the word *ich*, the position of I seems too narrow for it, although they say gùət for gūt *good*, gedìənt, &c., where *id* accounts for the German and English *ie* spelling.

540. *We cannot determine* the relation of this χ̃ to the oriental aspirate of Q, (or surd of ghain,) having heard them at distant periods; but they are probably distinct.

541. *We use* χ *provisionally* (§386) for any Germanic or other allied *ch* sound which

* We have known a distinguished scholar to contend that 'sing' ought to be pronounced *sing-g*, because it has a final *g* in the spelling. This shows that the advantages of fōnŏtɛpɪ (compare cʌ́nɛpɪ,) are not confined to the unlettered. See §27, note.

has not been particularly described or discriminated, although the proper power of χ is that in the German *buch*. Pantoléon, who speaks Ellenic, ascribes to Greek χ both the sounds of *buch* and *ich*. The smooth ʿc is heard (before *e*, *i*,) in the Spanish general, registro, (=ʿcɛnĕrál, rɛʿcìstrŏ.)

542. ʿG *is recognised* in some dialects of German. We regard it as the sonant of ʿc. By G̃ (γ̃) we indicate the Ellenic (not Hellenic,) or modern Greek soft vibrant γ. *None of these* is the harsh oriental *gh* as we have heard it in Arabic and Armenian. This belongs to the deeper contact of Q. But most authorities consider the Germanic, Ellenic, and Oriental "*gh*" identic. Lepsius uses *r* for (G̃) the incorrectly named "guttural *r*," and Paulmier uses r′ for Arabic ghain. See § 513.

543. We adopt Mr. Ellis's two key words betro*g*en (ʿG) and köni*g*e (ʿγ, ɡ,) for the spirants of *g*. He adopts an additional character (a tailed i) for Spanish *j*.—*Universal Writing*, &c. p. 6′.

544. *The following notations* may be compared. Properly as the ɢ character (meaning the form of Pitman and Ellis, is formed on C, the ʿγ should be formed on G with the same appendage.

	buch,	*ich,*	*tage,*	*täglich.*		
	ʿc	ɢ	ʿG	ɡ (ʿγ)	γ̃	χ̃
Ellis	x	ɢ	ɣ	*g*		
Lepsius	χʿ	χʿ	χʾ	χ̌	ṙ	
Müller	ʿh	ʿ*y*	ʾh	ʾ*y*		
Rapp	χ	*x*	*j*ʿ	*j*ʾ		

545. *We follow Rapp, Böhtlingk, Sjögren, Castrén,* Matushik, Sᵛuñicʿ, and Poklukar, in adopting the character 'J' for the initial of the English *year*, Belg. *jaar*, and German *jahr;* Latin JUGUᵐ, Ital. jugo (and giogo,) Spanish yugo, Gothic juk, Ger. joch, Angl. geoc, joc, Eng. yoke, = JOC. J is used with its historic value in the *English* alphabets of Hart, 1851; R. R., Phonotypic J. 1846. p. 160; and the Rev. W. M. Reynolds, (President of Wittenberg College, Ohio,) 1846.*

546. *The surd aspirate* ″J occurs in the English *hue, hew;*—yh of its discoverer Ellis.

546*a*. *Nasal* J, *occurs in Jakutish.* Böhtlingk's letter is j with a horizontal line through the top. We have heard it in Cherokee.

* He says (Lit. Record of Penna. College, Vol. 1, p. 48,)—"The letters C, Q, X and Y are rejected, the first three as superfluous, and the Y *on account of its unsettled power* in English as well as in other languages." Here an author, by following Lepsius's Rule III, p. 32, rejects *y* and adopts *j*, whilst Lepsius does the reverse—thus demonstrating that the 'rule' which was unphilosophic is also impracticable, and therefore no *Rule*. See § 167, end of the note.

FAUCALS.

Q q, Q̃, 2̃ (2.)

547. *By faucals we mean* certain consonants of which the type is the oriental Q *qaf*, the 21st letter of the Arabic alphabet, and (ק) the 19th of the Hebrew. Qaf is a kind of posterior *cay*, made behind the palatal veil, and therefore incapable of nasality. Guided by description, we pronounced them correctly (except *ain*) before hearing them in nature.

548. *The surd aspirate of* Q is the seventh Arabic letter *qha*. Richardson says "it is generated by a gentle *vibration* in the throat." This removes it from Greek (χ) and German *ch*. Its letter would be ʿQ, but as this implies a smooth form, it is better to indicate the vibration by Q̃, or still better Q̃ʿ.

549. *The sonant of* Q̃ is the 19th letter '*ghain*' of the Arabic alphabet, and the third '*gimel*' (= gĭjmɛl,) of the Hebrew. We indicate it by 2 (not 2 with a straight base,) from its similarity to Q. The mark of vibration would be an advantage, and should a lenis form occur, its sign would be ʾ2.* Richardson (Arabic Dict.) says correctly, that it is "articulated in the throat with a *vibration* producing a sound like that given to *r* by the Northumbrians, or the noise made in *gargling*. . . . It seems to bear the same relation to *kh* as *b* to *p*." It is not the German *g* in *regen*, § 542.

550. *We cite Armenian examples* of Q̃, 2̃,—which, though identic with the Arabic equivalents, they seem to have a dialectic variation, as we have heard Armenian ghain replaced with Ellenic ghamma, § 542. The letters are purposely varied for comparison, here and in the next paragraph.

dəndə2̃á,	*a cymbal.*	q̃ɛlc,	*the mind.*
Q̃ʁ̆Q̃ʁ̆ntɾɛl,	*a neigh.*	Q̃ătɾ,	*a crucifix.*

551. *As independent* p|φ, t|θ, c|χ, can be formed without air from the lungs (§ 446,) so in the Chinook of Oregon, q|ˢq is similarly treated, according to the pronunciation of Dr. J. K. Townsend, which we acquired. But Mr. Hale makes the sound tχl, in which he is probably wrong, because all agree that the Chinook sound is a very difficult one to pronounce, whilst Hale's is an easy combination. Moreover, the effect upon the ear is not unlike that in the word for *thigh* given in § 448, which we learnt in nature. In the fol-

* Mr. Hale notices a sound which may be a variety of this, in the Patagonian language. It is formed in the innermost part of the mouth, which opens a little, the tip of the tongue being applied to the lower gum. The *sonant* of Q seems to occur in Berber, and dialectically in Arabic—judging from the paper of F. W. Newman, Esq., in the Philol. Soc. Proceedings, 1843 ,Vol. 1, p. 137.

lowing examples (in which allowance must be made for two 'personal equations') the vowels are normal, and the diphthong as in *out*.

bĕʁq|ʿqèq|ʿqē, *grandmother*. ɋ|ʿqa̤ɋ|q̤ʿa̤ʁɋ|ʿq, *yellow*.*

LARYNGALS.

ʾ	ʾ	⊳	ʿ	*lenis*.
1	2	3	4	
··	ʿ	h	ḥ	6, 7, 8, *aspirate*.
5	6	7	8	

552. *The laryngal contact* pertains to the larynx, and we adopt the term in preference to *glottal*, because this is commonly made to include the faucals or pharyngals. But the faucals of Lepsius are our laryngals.

553. *Many deny* that *h* is a consonant, because 'it is not made by contact or interruption.' But when the breath is impelled through an aperture which obstructs it, there is interruption, and if we vary the impulse we can make English *oo* and *w* with the same aperture.

554. *The walls of the glottis* can close, thus forming a consonant contact; and as the glottal fissure (§ 148) is the narrowest part of the breathing tube, it is the seat of the deepest point of interruption, and of *h*.

555. *The spiritus lenis* (') has been described in § 115*a*, but authors are not agreed about it. Some make it the Hebrew aleph, and Arabic hamza, about which opinions differ also. Max Müller says (Languages of the Seat of War, p. xxvii.–viii.,)—"We can more easily perceive what is meant by the spiritus lenis inherent in every unaspirated initial vowel, if we pronounce b l a c k i n g and b l a c k i n k . . . in b l a c k i n k, the i is ushered in by the spiritus lenis. This spiritus lenis is the Hamzeh of the Arabs. . . . Its sound is produced by the opening of the larynx, but there is no previous effort of closing the larynx which alone could be said to give it an explosive character." *a*. This describes the spiritus lenis as understood by moderns, *but the hamza is nothing like it*.

556. *Ellis gives the spiritus lenis* as occurring between *ao* in *a,orta*, being "the slight effort made when any vowel sound is uttered," whilst in the hamza—"the effort of

* This sound is probably identic with that described by the late Rev. Emmanuel Naxera, a Mexican ecclesiastic, as found in the Othomi language of that country. "K simplex vel duplex est. Duplex Hispano-Mexicani grammatici *cc castanuelas* vocant, quia ejus sonus similis est stridori à simiâ facto, nuces frangenti. Litteris *cc*, *qq*, vel. *qh* oculis pingitur. T, aliquandò etiàm sonitu effertur." (§ 448.)—Am. Phil. Trans. Vol. V, new series, p. 254, 1837.

This Tshinook faucal may be the Hottentot guttural clack, described by Thunberg as "the most difficult of all, and performed quite low down in the throat, with the very root of the tongue."

enunciation and separation of the following vowel from preceding sounds is more distinct. An exaggeration of this produces a kind of *bleat*, which is the true Arabic *gain*."—Univ. Writing, p. 5″ below.

557. *Lepsius says*—"By closing the throat and then opening it to pronounce a vowel, we produce the slight explosive sound which in the Eastern languages is marked separately, but not in the European, except in the Greek. We perceive it distinctly between two vowels which, following each other, are pronounced separately, as in *go 'over*." Here the *hamza is correctly described*, and the English effect improperly referred to it.

558. *We do not think it necessary* to represent the initial effect of *at* (*'at*, or better—ʰat, or ʿaat, with whispered *a*,) as distinguished from *hat*, unless the glottis is closed—and we do not mean the *epiglottis*, which cannot act in speech.

559. *We deem the effect* in black ¨ink, a¨órta, go ¨over, Fr. le ¨héros, as a separation akin to diaeresis (§168,) or an accentual difference without separation, as in zóŏphyte, néŏphyte, zŏólogy, nĕólogy.

560. *Hiatus* (ʾ) *is a break or pause* commonly caused by dropping an intermediate element and not closing the remainder, the word and each of its constituents retaining their proper length, as in saying *a ʾorse* (not *a orse*,) for *a horse*, or *a ¨orse*. See Ellis, Essentials, p. 41. It would occur in zo-ophyte, if the least pause were made, and avoiding *hamza*.

561. *Such a hiatus* has been attributed to the name Hawai'i, as compared with the earlier New Zealand word hawai*k*i. But whilst one traveller called our attention to this 'hiatus,' two others pronounced this word (as they believed) in the native mode, with a genuine hamza. (§568.) Wm. Ellis (Polynesian Researches, vol. 4, ch. 2,) does not mention anything of the kind in giving the pronunciation of *Hawaii*, but in his appendix on the language, he speaks of "a peculiar break" distinguishing *o'u* (*I*) from *ou* (*you*,) this being, as it seems, a diphthong beginning with true *o*.

562. *We do not adopt the two dots* of §§227, 306, to indicate hiatus, because they are used for an etymologic ¨and not for a phonetic purpose; and because we prefer a sign more like that used for the (hamza, §568,) closure of the glottis—although *hiatus does not belong to any contact.*

563. *The sign* (ʿ) *represents the slight phase*, whether aspirate, independent (§446,) or even vocal, at the close of abrupt syllables, as in *tapʿ*, tubʿ, or tubḥ.

564. *The sign* (ʾ) *indicates* the opposite phase to ʿ, where the breath is not allowed to escape after *tapʾ* (the lips remaining closed,) as in Chinese. This inconvenient notation is preferred to (ʾ) because this is used to contradict aspiration like that of *s*, *p̓*, not the

false 'aspiration' like that of *p* in 'haphazard,' which is no more aspirate than the *p* in *up stairs.*

565. H, h, *is the common English* and German *h*, in the syllables held, hat, hast, hose. It is unknown to French, Italian, Spanish, Russian, and Ellenic.

566. ħ, ɸ, *is for the eighth Hebrew* letter hheth (=ɸejϑ,) and the sixth (hha) of the Arabic alphabet. We adopt the Greek ψ inverted (but of a better form than these,) which is nearly the Ethiopic and Amharic letter of probably the same Arabic *hha.*

567. ħ (ḫ) *is commonly called* an emphatic *h*, and often represented by *hh.* As heard by us, it is an enforced, somewhat *close h*, with a tendency to scrape along the throat, and consequently, it is not a pulmonic aspirate. But S^v^uñic' probably describes a different element, for he compares it to the *open* coughing of an ox, which differs from *h* as warm or pulmonic breath differs from it.* The glottis would be opened for such an element beyond the normal position, so as to render more lung exertion necessary, to give it body. The pulmonic breath is often used in the continuous portion of a cough. Should these two varieties be found to exist in speech, they will run (from the closer to the more open direction) ɸ, h, ḫ.

567*a*. *The Florentine aspirate* in casa, misericordia, *ch*i, we have casually heard, and believe it to be ɸ, and also the Spanish *j*, *x*, before *a*, *o*, *u*, as in jabon (soap, = ɸă'bón,) and the geographical name San Juan (= săn ɸ v̊an,) in English—sʌn v̊vɒn, which a Chinese would accept for 'crooked mountain.'

568. *Hamza is a closure of the glottis,* which we indicate by ⊳. It occurs as a cutting off of the breath at the beginning of a cough, (⊳h, or ⊳ħ,) during laughter, and when the breath is held in lifting a heavy weight, or in leaping. It is found in Wyandot (§ 486) and Chippeway.

569. *Rapp considers the spiritus lenis* a closure, and writes it (1, 84) with *ɥ*. He cites a South German negation (1,166; 2,267,) with which we are vernacularly familiar, as "*hãɥɥã*," doubling the sign to shorten the (nasal) vowel.† We would write it (with *h* nasal ¨also, h˵ɐ˵˜ ⊳ ɐ˵˘, both vowels being short, the first accented.‡ It has several vowelless forms which he writes *hmmɥm*, *hnnɥn*, &c., (˸mm' ⊳ m, ˸nn' ⊳ n, ˸G˵G˵' ⊳ G, or ˸ΓΓ' ⊳ Γ.)

570. *The Arabic and Hebrew* ȁin Volney regarded as a vowel modification, using a marked a (e, o) for it, the sound being formed with a varying vowel aperture. The vowel is heard with a simultaneous faucal scrape, which may be regarded as a sufficient

* See Ellis, Essentials, p. 40, § 5, 6

† The corresponding *yes*, which Rapp writes "*hmhm*" is rather m˸mm', the second syllable accented. In English a single long *m* is sometimes used for *yes*, as cited in Medhurst's Chinese Dictionary.

‡ Not having examined Ellenic with a view to detect hamza, we have no settled opinion in regard to the *ancient* spiritus lenis.

interruption to make a modified liquid; and the vowel and scraping effect being simultaneous, they cannot be represented by a consonant character preceding a vowel one, as ⊰a. We propose a minute ⊲ below the vowel character.

571. *The sanscrit visarga* (:) is a final "strong aspirate" (Sir W. J.) which becomes *s* in languages which do not admit it, as the Hebrew final of *Jonah*, *Jeremiah*, is either pronounced *s*, or supprest. The Sanscrit sound was probably *h* pronounced with the mouth not sufficiently open, causing the breath to strike along the fauces and palate, thereby receiving a modification suggestive of χ and *s*. We represent it by the figure 5, which is sufficiently like one of the German forms of capital *h*, whilst it is equally suggestive of *s*.

572. *The following systems of notation* have been proposed or used for the members of this, and of the preceding contact.

	FAUCALS.			‖	LARYNGALS.			
	Q	Q̃	2	h	ħ	¨	⊳	⊲
Hebrew,	ק	כ	ג	ה	ח		א	ע
Volney,	q	χ	γ	h	h*		'	a*
Lepsius,	*q*	χ	χ'	*h*	*h*ʿ		'	'
Richardson,	ḳ	kh	gh	ḥ	ḥ			**
Müller,	q	ʿ*h*	'*h*	h	hʿ	'		'h
Paulmier,	k′	kh	r′	h	h′			'
Eichhoff,	ꝁ	ꝁ′	ꝡ′	н	н†			*A, &c.
Ellis,	q	x	*g*·*	h	h*	ɩ	a*	ɛ
Sᵛuñic′,	ʿk	ḣ	ġ	h				**
Riggs,			ġ	h				

* A peculiar form on this basis. ** The Arabic letter. † With a short vertical medial line.

LARYNGO-FAUCAL.

Q q.

573. *In the Waco of Texas*, the entire surface from the glottis to the Q position, form a contact which is opened suddenly and independent of the lungs, upon a vowel conformation, producing a clack or smack like that which accompanies the separation of the closed palms when wet with soap and water. The preceding closure bears some resemblance to the incipient act of swallowing. We describe it from our mode of producing it, and we were said to be the first person with whom it was not vernacular, who had acquired it.*

* We pronounced Arabic *q*, *qh*, and *gh*, and Welsh *ll*, *rh*, as ascertained from descriptions, before they had been heard from natives, but we did not recognise *hamza* from the descriptions, although we were familiar with the phenomenon.

574. *The following words are Waco* (vɛ̀co,) the *r* being the vibrant European element. The word for *nose* (tɩ′sa ⊳ ˑ,) is (except the first vowel,) whispered.

cɩtɩcq ⊢ₒ,	*eye.*	cɩtɩcèsq ⊢ₒ,	*brow.*
ʊ˘rsq ⊢ₒ,	*foot.*	ʊ˘rsèt·q ⊢ₒ,	*shoe.*
ˊsq ⊢ₒ,	*hand.*	ɩsq ⊳ ɛtsq ⊢ₒ,	*finger.*
ècn″vva·rq ⊢ₒ,	*leggins.*	ɩscvɩtsq ⊢ₒ,	*finger-nail.*
ʊ'tsq ⊢ₒ ʊrsq ⊢ₒ,	*cheek.*	cècq ⊢ₒ,	*breast.*

575. *The following is our arrangement* of the consonants according to the scheme in § 193, excluding theoretic ones. The blanks are useful in showing the phases which are not known to be in use. Letters separated by a comma, belong to the same point of contact, as the semi-vowel V (No. 5) and its coalescent.

576. *There are four great divisions* of the consonants, according to their formation by the *lips*, the *apex* of the tongue, the *base* of the tongue, and the *larynx*.

577. SCHEME OF THE CONSONANTS.

					labial. § 451–3	dental. 469	sigmal. 495	lingual. 485	cerebral. 491	palatal. 514	guttural. 525	faucal. 547	laryngal. 552
INTERRUPTION	little	nasal LIQUIDS.	sonant	lenis 1	v, ˑv		-	-	-	ʒ,	J, ʒ,	-	‹
				asper 2	-,		-	-	-	-	-	-	-
			surd	lenis 3	-,		-	-	-	-	-	-	-
				asper 4	-,		-	-	-	-	-	-	-
		pure	sonant	lenis 5	v, ˑv	l ⊢ r,	v,	ɾ l,	l,	ʒ	J, ˑʒ	-	-
				asper 6	-	ˑl?	-, ˑr,	-	-	-	-	-	-
			surd	lenis 7	-	-	-	-	-	-	-	-	⊳
				asper 8	″v	″l	″r, ″r,	-	-	″ʒ	″J	5	h, ħ
	much	nasal MUTES.	sonant	lenis 1′	m	n	-	n,	n,	-	ʃ		
				asper 2′	-,	ˑn	-	-	-	J, ? § 198	-		
			surd	lenis 3′	-,	-	-	-	-	-	-		
				asper 4′	ˏm	ˏn	-	-	-	-	-		
		pure	sonant	lenis 5′	b	d	-	d,	d,	-	G	-	
				asper 6′	ˑb ʁ ɑ		-	ʒ ð ʒ,	-	J	ʒ ˑG	2	
			surd	lenis 7′	p	t	-	t,	t,	-	c	q	q ⊳
				asper 8′	ˑp f ϑ		-	s ɔ s, § 490	s,	f	ç ˑc	ˑq	-

CHAPTER XVI.

EXAMPLES.

The difficulties attending the construction of a phonetic alphabet are so great, that those who have not spent many months over the task, can have no adequate conception of them. After the invention of an alphabet which seems theoretically perfect, the luckless inventor too frequently finds, that when practically applied it will not realise his expectations. Even should it work tolerably well, the difficult question arises how far to employ it properly. Phonetic spelling is more difficult in English than it would be in any other language, though if the Irish or Scotch pronunciation were adopted, or even that of the laboring classes in the agricultural districts, the task would be comparatively easy.—*Phonotypic Journal*, 1846, p. 156.

In expressing the sounds of a new language . . . the missionary should be guided entirely by ear, without paying any regard to etymological considerations, which are too apt to mislead even the most accomplished scholar. *Max Muller*, p. xx. . . . we feel how essential it is, in a first attempt to fix a spoken language, that the writer should not be swayed by any hasty etymological theories. The missionary should give *a true transcript of a spoken language*, and leave it to others to decipher it. Id. lxxxi.

§ 578. *Some languages are readily written*, even by children, and it is difficult for one who knows English alone, to believe that various languages have no more than the five primary vowels of Latin; or that the vowel of *up* is not universal. Yet in Dacòta, "The vowels are five in number, and have each one uniform sound," except when nasalised, and "all the syllables are enunciated plainly and fully." The vowels are "*a* in *father*, *e* in *they*, *i* in *marine*, *o* in *go*, and *u* in *food*."—*Riggs*. In Hawaiian, "*a* is always as in *father*, or shorter as in *ăha*, *e* in *hate*, *i* in *machine*, *o* in *no*, *u* in *food*. The short sound of *i* in *bit* seldom occurs."—*Wm. Ellis*, Polynesian Researches.

579. *The unwritten Polynesian languages* have perhaps more resemblance than French and Italian, Anglish and English, although they have been separated probably two thousand years; and Ellenic has been permanent for the last three centuries, whilst English has greatly varied, and is still quite unsettled.

580. *English is an unsettled language*, because, being composite, its materials have not yet acquired their natural relations to each other, wherein it resembles a chemical mixture which requires many years or cycles before the results of the various affinities appear in a permanent crystallisation.

581. *The orthoepists blind themselves* to the genius and tendencies of the language, and represent a jargon which no one uses but the child learning to read from divided syllables, who turns 'li-on' into *lie on;* or the German, who fancies that the first syllable of 'phantom' occurs in 'elephant,' because they resemble in German and French.

582. *We do not object* to writing words syllabically, if the correct syllables are used—if *gu* in *gun* is admitted in *ágony*, rather than *go* or *gone*, the use of which would justify 'gone-shot' for *gunshot*, and 'gone'r' for *gunner*. Such syllabic spelling would be like a

theory of the catenary curve drawn from the consideration of a single detached link hung upon two nails,—such factitious forms being less like words than a link is like a chain.

583. *Every English word* of three or more syllables requires the vowel ɐ, ə, ɪ, or a syllable without a vowel, when the structure of the word does not interfere with it, as *graduate, self-sameness, portmanteau,* and the difficulty is to decide upon the proper vowel, as in cand*i*date, ag*i*tate, el*e*vate, exp*e*dite, av*e*nue, mal*a*diction,—for vernacular practice cannot be controlled by the consideration that the original was an adverb rather than an adjective, unless it can be shown that the adverbial form has been preserved in speech, and we think it is not. With the spelling we have nothing to do.

584. *Phonetic readings* of '*usual*' and '*feature,*' with *zh-y-oo, tsh-y-oo,* we do not consider English, because *y* of *u* or *yoo* has become *zh, sh,* leaving a vowel without a preceding *y.* (§ 311.) Nor is *dif*-thong correct, having been dissimilated, (§ 292–3,) and none but a scholar, a greekist, (not Greeceist,) or foreigner, could sanction an English form like 'dif-thon-dzhise' (for dip-thong-ise,) a form which would allow but one word for *singing* and *singeing.* Farther, a *cramberry* is no more a *cran* berry than 'amber' is *anber,* 'imbue' *inbue,* or 'aunt' *amt,* Latin A˘MĭTă.*

585. *It is supposed by some* that English spelling "corresponded at some time or other to the sound of words." (Müller, p. xviii.) We think not. English never had signs for its commonest vowels, and as it is difficult to determine where they occur, the orthoepists find it easier to follow the accidents of a spelling which at no time represented the language, than to enter seriously upon an inquiry into the laws of English speech. We admit that words like *action* once had *o,* and ended with *own,* as in Spanish and German, but we doubt whether the *on* of *honest* ever formed a part of them, and we *know* that it does not occur in the English of 1858. The vowel of *ebb* is common enough in English, but hardly so common as to occur thirteen times in fourteen consecutive words containing sixty elements, thus constituting one-fifth of the whole. Yet it has been indicated as occurring thus in the fragment—"several passages were then inserted, and in

* We do not recommend our own pronunciation,—forms like tra-vlr, difrns, instnsz, genrl, temprns, being too condensed—too Attic, for ordinary use, besides being more influenced by the spelling than the genius of the language allows. In looking through the Phonetic periodicals, whilst preparing this essay, we find that we have been ignorant of the name of many public characters. To us there was a fictitious Clánricàrd within two weeks, and whilst we know that our two friends "Mackay" are respectively Mɛcè and Mɛcɔ̀j, we do not know the name of the poet Charles Mackay, though we have heard him named Mǽcɪ. We mispronounced the proper names Tyrwhitt, Napier, Hereford, Bowring (a gentleman we have more recently met,) Keightley (which we had classed with Weightman,) Howick, Moore, Mavor, Latham, Youatt, Lowth, Houghton (Hoton, which we classed with Hough, or Huf,) 'Aurora Leigh,' leg? lay? lee? lie? Once, when in Boston, Massachusetts, with a fellow traveller, we wished to see a public building of which we had read, named Faneuil Hall, and after discussing what we should ask for, we wisely concluded that the natives would not understand us, or would laugh at our pronunciation—so we neither saw the building nor learnt its name.

them some errors occur, which he begs"—Our own pronunciation of *statue* is stát-yoo= stʌtjʊ, but it appears that some pronounce it with tr, in *chew*. In a phonetic periodical, the former is preferred, because "it is a neater sound, and is more pleasant to the eye." That is, 't' is handsomer than the character which was then used for tr. But the argument falls with the fall of the character, and such arguments are not valid at any time.

586. *The French words* 'dépendance' and 'diffidence' with their identic final syllable, were received as identic, and have so remained. Yet a few elocutionists will have it that one of these now English words ends like *dance* and the other like *dense*. But even were this so, as the English and French do not usually alter their orthography with the variations of speech, it is likely that the *dense* pronunciation would have fallen to 'dependance,' and *dance* to 'diffidence,' as in the Italian 'dipendenza' and 'diffidanza.'

587. *Some prefer the pronunciation* of men of letters, but in the present state of phonetic and prosodic knowledge, as exhibited in the great majority of the grammars, men of letters constitute the ignorant class, with the perversions of French analogies added to their ignorance; and if the vulgar corrupt (develop?) words, they are at least true to the vernacular laws. But in comparing a lettered with an illiterate pronunciation, the two must be of the same locality and dialect, *church* cannot be judged by *kirk;* and the words must be vernacular, as one, two, three; body, head, arm, eye;—land, field, water, fire, house, rain, star, sun, moon.

588. *The misuse of h is unknown* to large districts and various dialects. In fact, although we have known *h* to be omitted, we have never heard *hat* for *at*, *hear* for *ear*, &c. As the Welsh *poat* for *boat* is due to the Welsh law of permutation, so the cockney misplacement of *h* may be a C^{k}eltic remnant based on a form like the Irish *an oigh* (the virgin,) *na hogha* (of the virgins.)*

589. *The three different vowels* of *ooze*, *up*, *eel*, were once given to us by three lettered Cherokees as occurring in the second syllable (of four) of their word for *eight*. We considered it likely that the *u*p was correct, although a 'syllabic' writer might have considered it as certainly wrong; but when we asked an unlettered native, he used no vowel whatever in this place, and we deemed him correct and the others perverted by their syl-

* But more probably the misuse of *h*, and the confusion between English *w* and *v*, are due to the differences between the dialects of Anglish and those of French. Anglish and Latin had English *w*, which the French replaced with their *v*, so that there was a continual conflict between the two in words like *will*, *wall*, *way*, *veer;* and in *wine* and *vin*-egar the result is heterogeneous. H, which is stable in Teutonic, is evanescent in Romanic, and wanting in modern French, which accounts for its misuse in the natural dialect of the South of England. It is worthy of remark that the analogous confusion between sonant and surd *th* existing in the dialects of Anglish, has resulted in uniformity, independently of the spelling; for practice varied to such an extent that on the adoption of the Roman alphabet, both were represented by *th*—which each reader was expected to read in his own mode.

labic alphabet, which forces them to write fictitiously, and then to speak as they write, instead of doing the reverse. The word was cu˘lcvōcı´, in three syllables, and having Welsh *ll*. Similarly, if one orthoepist would model *seven* on the Gothic sib*un*, another on the Anglish syf*on*, and a third on the old *E*nglish sev*en*, or Belgian sèɛɛn (with ɛ of *end*,) we would still prefer saying *sevn* (= sɛɛn,) with the *I*nglish.

ENGLISH.

590. *As there is much confusion* between the medial of the *awe* vowel in pond, cross, dross, horse, (§ 403;) and that of *odd* in rod, John, (§ 407,) transition forms will be found useful until practice determines how the difficulties are to be avoided. We will therefore use ɑ· provisionally for the open medials, as in *George*, ɔ· for the close, as in *John*, and ȣ or ǫ for the doubtful.

591. *The labial vowels* have a similar difficulty, and may require a transition letter, (as Mr. Pitman's angular u, for doubtful forms like *brew*, *imbrue*, *crew*, § 424–5, which we are hardly competent to decide upon. Leaving quantity out of the question, we pronounce *brew*, &c., with u whilst Worcester (=vust*v*,) probably the most judicious of the English orthoepists, refers them to the key word *move*.

592. VOWELS.

1	a	*a*rm	§ 370.	10	ʌ	*a*isle	§ 400.
2	ɐ	*u*p	374.	11	ɑ	*a*we	402.
3	ʌ	*a*dd	378.	11′	(ǫ	pond, rod)	403, 407.
4	ɛ̃	thêre	388.	12	ɔ	*o*dd	405.
5	ɛ	*e*bb	384.	13	o	*o*we	416.
6	e	th*e*y	391.	13′	(o	whole)	415.
7	ə	buffet	392.	14	u	p*oo*l	422.
8	ı	p*i*ty	395.	–	(..	crew)	591.
9	ı	f*i*eld	399.	15	ʊ	p*u*ll	424.

593. CONSONANTS.

1	v̇	no*w*								25	j̇		
2	v	*w*ay	10	l	16	r	17	ɾ	18	ɾ	21	ʒ	26	J	
3	v̈	*wh*ey	–				–				22	ʒ̆	27	J̆	31 h
4	m		11	n			–				–		28	Γ	
5	m̈	*hm*	–				–				–		–		
6	b		12	d			–				–		29	G	
7	ɐ	*v*ein	13	ɑ			19	ʒ			23	J	–		
8	p		14	t			–				–		30	c	
9	f		15	ʇ			20	s			24	ʃ	–		
§§	541–59.		464–9.				495.				514.		525.		

594. *The vowel writing forms* are as follows. No. 2, an *ι* wide below, with the loop of *e* added separately; or, a figure 1 with *e* added against it, being Mr. Graham's letter for the vowel of *her*. The more open *ʊ* of *urn*, if required, to be similarly made of *ɪe;* or like *ʊ*, by beginning with the top hook, then forming the loop and finishing the base. No. 3, Greek *α* made by commencing with the top of *ι*, then curving down towards the left, forming the circle, and finishing the end of the *ι*;—or, making a character (ɑ) like '&' without the upper loop. No. 4, when not satisfactorily made, may have the circumflex (^) placed over it. No. 8, like *i*, but running into (‿) below; it is not to be dotted unless to prevent obscurity. No 9, the common *i*, a bad letter, because it forms part of *u*, and requires a dot, but *not in print*. A good script form is a desideratum. No. 10, like *a* with a break to the left in the middle of the *ι* part;—or, with the *ι* made straight, and a tail thrown back into the *o*, as *t* is sometimes made without lifting the pen. The latter is Mr. Graham's *a* in *at*. No. 11, *a* with an inward break on the left of the *o*.

595. *The consonant writing forms* are as follows. No. 2, the common *v*. No. 1, the same dotted, or *ʋ* to avoid the marking. No. 3, a straight line running into a curve (‿) continued up and ending like *v*, unless appropriated in some language. No. 3, 5, 22, 27, may have the surd mark omitted, but in writing only. No. 7, a *v* with a break towards the right, in the middle of the descending stem. No. 17, as printed, or the form of *r* made with the ascending stroke continued into (˘) a short quantity mark, and ending with *ι*. (This would have formed a good character for *i*.) No. 18, *r* with the stem running below the line. No. 23, we use Mr. Ellis's character, a line (*l*) continuing into an inverted script *l* or *γ*. No. 24, a long script *s*. No. 25, like *j* with two dots, or, to avoid these, the tail may be turned to the right.

596. *Observe* that, as in English, the coalescents No. 1 and 25 are never initial, and always follow vowels; they may be represented by v and j, but only in writing. §173; Rule 1, 2, §47, 56.

597. *The different order* given to the alphabetic characters is a great barrier to the use of dictionaries, as in those of Hebrew, Russian, and Sanscrit. It is even inconvenient to use Greek and Latin lexicons at the same time, or Danish and German. Thus in Danish and Swedish, *ö*, &c., follow *z*, so that Dan. bœlte (belt) follows bytte (booty;) and Sw. däck (deck,) and död (death) come after dum (dull,) and dyr (dear.)

598. *The attempts to arrange the alphabet* in physiological order have not been satisfactory; in fact, it cannot be done in a single series, and would be more inconvenient than useful in dictionaries. We therefore interpolate the new English letters among those of the Latin alphabet. This gives the series—

599.

a	ʌ	ɑ	ɑ	ɒ	b	c	d					
e	ɛ	ɛ	ɐ	ə	f	ɢ	h					
ɪ	ɪ	j	ɟ	ʝ	l	m	m̊	n	ʃ			
o	p	r	ɾ	ɾ	s	ɜ	ɟ	ʝ	ʃ	ɟ	ɪ	ɑ	t
u	ʊ	v̇	'	v	v̊	ɮ						

COLLOQUIAL ENGLISH.

600. *The following example* is transliterated from one given by Ellis, (Essentials, p. 104,) being his translation of a passage from Pott's Etymologic Researches, and printed here *without any perversion of the powers of the Latin alphabet.*

601. For convenience of printing in this version we use ɟ for the more anterior ʝ, ɐ for a, r undotted (§ 501,) U for U, and j, v, for the coalescents; and although ɟ, ɟ, are identic, ɟ is preferred in certain positions when printed, to increase the distinctness.

602.

The written and printed representation of the sounds of language by means
ɑɐ rɪtn ənd prɪntəd rɛpɾɪʒɛntèɾən əɛ ɑɐ sʌvndə əɛ lɪʃɢvɪdɟ bʌj mɪnə
of characters which are insufficient both in kind and number, and which must therefore
əɛ cɪ´ɾəctɾə, v̊vɪɾ aɾ ɪnsɐfɪ´ɾənt, bŏɪ ɪn cʌjnd ənd nɐ´mbɾ, ənd v̊vɪtɾ mɐst ɑɛɾfŏɾ
be combined or modified if we would give a graphical symbolisation of
bɪ cɐmbʌjnd ɑ·ɾ [§ 403, 7, 8,] mŏdəfʌjd ɪf vɪ vʊd ɢɪɛ ɐ ɢɾɪ´fɪcl sɪmbl¨ɪʒeɾən əɛ
the phonetic elements with only some degree of exactness and convenience, has been, from
ɑɐ fŏnɛtɪc éləmənts vɪɑ ónlɪ sɐm dɪɢɾì əɛ ɛɢəʌctnɛs ənd cɐnɛìnɟəns, hʌə bɪn, fɾɐm
all time, for nations as well as individuals, linguistical students not
ɑl tʌjm, fɑ·ɾ nêɾənə əə vɛl əə ɪndəɛɪdɟʊələ [ɪndəɛɪdɟəl] lɪʃɢvɪstɪcl stɟʊdnts nŏt
excepted, one of the most necessary and one of the most difficult of problems, and has
ɛcséptəd, vɐn əɛ ɑɐ mŏst nésəsəɾɪ ənd vɐn əɛ ɑɐ mŏst dɪfɪcəlt əɛ pɾŏbləmə, ənd hʌə
consequently scarcely ever been happily solved. Let this teach us that the invention
cŏnsɪcvəntlɪ scɛ´ɾslɪ ɛɛɾ bɪn hʌpəlɪ sɑ·lɛd. lɛt ɑɪs tìtɾ ɐs ɑɐt ɑɐ ɪnɛ ɛ nɾən
of writing, the greatest and most important invention which the human mind has
ɑɐ rʌjtɪɾ, ɑɐ ɢɾetəst n mŏst ɪmpɑ´ɾtnt ɪnɛénɾən v̊vɪtɾ ɑɐ ɟ̊ɟʊ`mən mʌjnd [mænd] hʌə
ever made, and which, as it indeed almost exceeds its strength, has been often
éɛɾ med, ənd v̊vɪtɾ, ʌə ɪt ɪndìd ɑlmŏst ɛcsìd ɪts stɾɛɾ [stɾɛnʔ?] hʌə bɪn ɑ·`fn
and not unjustly attributed to the gods; like the organism of a state, at once
[ŏfn] ənd nŏt ɐndɟɐ´stlɪ ʌtɾɪ´bɟətəd tɐ ɑɐ ɢɑ·də; lʌjc ɑɐ ŏɾɢənɪəm əɛ ɐ stĕt, ʌt vɐns
simple and complex, is not the work of individuals but of centuries perhaps of
sɪ´mpl ən cŏmplɛcs, ɪə nŏt ɒɐ vɐɾc əɛ ɪndəɛɪ´dɟʊələ bɐt əɛ sé́ntʝʝɐɾɪə pəɾhʌps əɛ
thousands of years.
ɪʌ´vəndə əɛ ɟɪɟə.

603. *This specimen has suggested to us* the probability that three kinds of *r* will confuse many writers, so that practically 'r' initial, and 'ɾ' will be sufficient; but if 'r' is restricted to a single tap of the tongue (§ 501,) it should have a superior dot—neglected here, from the difficulty of printing it.

604. *We at first wrote* 'students' with 'ə,' then excluded it, and we changed the second vowel of 'individual' from ɪ to ə, although we use ɪ in our own speech, from heterotypic influences, as we believe. We think the cases rare, where the same vowel occurs thrice in the same word. It seems contrary to the laws of English.

605. *We had written* 'representation' without a vowel in -tion,—and 'invention' with it, but finding a vowel aperture to be made, we wrote ə, which is correctly placed in problem, convenience, greatest, exactness,—but is it not ʊ? in human, and difficult. We think not. Nevertheless, a difficulty in discriminating them may require ʊ to be used for both, in the one case (ə) dotting it beneath. At first we assigned ʊ to organism, then ə.

606. *The words* 'therefore' and 'scarcely,' in which the open ɛ of thêre is shortened (as indicated by the acute accentual,) without closing to ɛ—may really require the use of 'e,' § 385–90.

607. FAVST,

'translated by Emma Stanwick.' Read ɑ, ɪ, e, o,`, *long*, unless otherwise marked; and ɔ, ʊ, ɪ,´, *short*.

608. Thou full-orb'd moon! Would thou wert gazing now,
609. ɑʌv fʊl-ɑɾbd̓ mu̓n! vʊd ɑʌ´v vʊɾt gèəɪg̣ nʌv,

For the last time upon my troubled brow!
fɑɾ [§ 403] ɑʊ last tʌ´jm ʊpɔ´n mɪ tɾʊ´bld bɾʌv!

Beside this desk, at midnight, seated here,
bɪsʌ´jd ɑɪs dɛ́sc̓, ɹt mɪ´dnæt, sìtəd hìɾ,

Oft have I watch'd to hail thy soothing beam;
ɑft hɹɛ æ vɑ´tɾt tʊ hel ɑæ sʊ̀ɑɪʃ bɪ̀m;

Then, pensive friend, thou cam'st, my soul to cheer;
ɑɛn, pɛ́nsɪɛ fɾɛ́nd̓, ɑʌv cèmst̓, mɪ sòl tʊ tɾìɾ;

Shedding o'er book and scrolls thy silv'ry gleam.
ɾɛ́dɪʃ oɾ bʊ´cs nd scɾɔ̀lə ɒæ sɪ´lɛɾɪ ɢlìm.

O that I could, in thy beloved light,
o ɑɛt æ cʊ´d, ɪn ɑæ´ bɪlʊ´ɛəd̓ læ´t,

Now wander freely on some Alpine height;
nʌ´v vɑ̀ndɾ fɾìlɪ ɔn sʊm ɹ´lpɪn hæt;

Could I round mountain caves with spirits ride,
cʊd ʌ´j rʌvnd mʌ´vntən cèɛə vɪɑ spɪ´rəts rʌ̀jd,

In thy mild radiance o'er the meadows glide,
ɪn ɑaj majldˑ rèdʒəns o.ɹ* ɑʊ méɾdəɜ ɢlaˋjd,

And purged from knowledge-fumes my strength renew,
ənd pʊ'ɾdɹd fɾʊm nɒ'lɪdʒ-fjʊˋmə mɪ stɾɛ́ɾɪ rɪnɹʊˋ,

Bathing my spirit in thy healing dew.
bèɑɪɾ mɪ spɪ'ɾət ɪn ɑʌj hìlɪɾ dɹʊˋ.

* 'oɹ' in line 6.

GERMAN.

610. *The next is the original* of the preceding example, which we retransliterate into German from Rapp's phonetic version (4, 92.) We follow Rapp's pronunciation, except that he uses a alone, for our a and ʌ. Had the phonetic version been our own, we would have put 'mondən' in the first line, and 'lɛtstən' in the second. The syllables without vowels are our own. Read ʊ, ʌ, short.

O sähest du voller monden-schein,
o əēst du [tu?] fŏlər mōndɛn-ɾʌjn,
o might you look full moonshine

Zum letzten mal auf meine pein,
tsʊ .m lɛtstɛn māl ʌ:vf mʌjnĕ pʌjn,
for the last time on my pain,

Den ich so manche mitter-nacht
dēn ɪɥ ɜo mʌnɥĕ mɪtr-nʌć̆t [nʌχt]
that I so often midnight

An diesen pult heran-gewacht;
vn dìɜəm pʊlt hɛɾʌ'n-ɢĕɓʌć̆t;
at this desk here watched;

dann über büchern und papier,
dʌn y˘br by˘ɥrn ʊnd [ʊnt?] pʌpìr,
then over books and paper,

Trüb-sel'ger freund erschienst du [tu?] mir!
try˘b-ɜēl.ɥər frʊ̆jnd ərrìnst du mìr!
sad friend shine you to me.

Ach könnt' ich doch auf berges-höhen
ʌć̆ cʊ˘nt˙ ɪɥ dŏć̆ ʌvf bɛrɥəs-hʊ.n
o could I but on mountain-height

In deinem lieben lichte gehen,
ɪn dʌ'jnəm lìbɛn lɪ'ɥtĕ ɢēn
in your loved light go

Um berges höhle mit geistern schweben,
ŭm bɛrɥəs hʊ˘lĕ mɪt ɢʌjstrn ɾɓèbɛn,
round mountain caves with spirits hover

Auf wiesen in deinem dämmer weben,
ʌ:vf ɓìɜɛn ɪn dʌjnəm dɛ́mr ɓèbɛn,
over meadows in your radiance float

Von allem wissens-qualm entladen
fŏn ʌ'ləm ɓɪsɛns-cɓʌlm ɛnt˙làdɛn
from all knowledge-vapor unburdened

In deinem thau gesund mich baden!
ɪn dʌ'jnəm tʌ':v ɢĕəʊ'nd mɪɥ bādɛn!
in your dew salubrious, me bathe.

WESTERWALDIAN.

612. *The following is the first verse* of a popular poem in the German dialect of the Westerwald district on the east side of the Rhein. It is given in K. Ch. L. Schmidt's Westerwäldisches Idiotikon, (Hadamar, 1800,) under the title—Das Hotzel-Mous-Lied, oder Lob der Hotzeln. A *hotzel* (*hútzel* in Pennsylvania,) is a dried apple, pear, or peach,

especially if dried entire, and *mous* in their cooked condition. The first line of the original stands—

Nu ha n' eich all mei*n* Lebelang—

where n' seems to be a fulcrum to prevent the concurrence of two vowels. The *i* of ich (*I*) will be observed to be diphthongal, as in English; and, in fact, most of the shades of English pronunciation are present in the idiotic forms of German and its cognates.

DʌˇS hŏtsl mūs.

613.

nū hŏ -n- ʌjǫ ʌˇl mu̯ˌj lēˈbəlʌʃ
now have I all my life-long

nʌvt bésərs ʌˇs hŏtsln gésə,
naught better as 'hootsls' eaten,

ˈbŏn ..ǫ tĕr cʌ̃ˌ hɛtˀ.. [hɛt] dʌ̃ ˈbēr [bǫr] ʌjǫ crʌˇʃc,
when (*wann*) I of-it none had, then were (subjnct.) I sick,

ˈbŏn īr ət rɛǫt [rɛǫt] ˈbəlt ˈbésə
if (*wenn*) you *it!* right would know.

cərʌ̃ˈptə mūr..n ən sʌvrcrʌvt
grated carrot an' saurkraut

əs ʌˈc noˈc (§ 411) ébəs [épəs] Gūs
is eke (*auch*) yet something (*etwas*) good

doc' ʌˈct -n- ʌjǫ dʌtˀ crʌ¯ ˈbu̯j nʌvt
though regard I that quite (*gar*) as naught,

ən ɛsə hŏtsl mūs.
an' eat dried-fruit mush.

FRENCH.

614. *The following table shows the discrepancy* of opinion among the French, upon the value of their vowels when compared with English standards. The first column contains the French examples, and the others the words supposed to contain the English equivalents.

	Le Brethon,	*Bolmar,*	*Value,*	*Picot,*	*Pantoléon.*
patte	pat	fat	add	at	. . . .
pâte	pall	arm	far	father	arm
bétte	bet	fate	gate	fate	ale
bête	bear	where	get	there	dare
hotte	hot	not	no, nor	nor, over	. . . .
hôte	hope	more	nor	" "	old

615. *The older alphabets* are not worth quoting. In the Miscellaneous Works of Wm. Marsden, F. R. S., there is a paper On a Conventional Roman Alphabet, where á is pro-

posed for the English and French—fall, mâle; a—sad, far; ă—manner; e—It. vero, Ger. lesen, Fr. cher; ĕ—It. nello, Ger. bett; ê—Fr. près; î—Fr. long î; i—the same short; (a correct feature;) ĭ—sit, It. piccolo, Fr. quitter; ô—glow; o—motive, (a correct view;) ô—not, It. dotto; u—Ger. and Ital.; ŭ—but, "In high German it is denoted by ü in für."—au, out.

616. *The example following* is nearly a transliteration of that of Mr. Ellis (Univ. Writ., p. 21,) whose panethnic notation we consider the best among the several modes proposed by him, and which the want of type alone prevents us from quoting. He indicates long vowels by a repetition of their character, which makes the sign of quantity heterogeneous (now *o*, now *e*,) and too conspicuous; nevertheless his palaeotype admits of a high degree of minuteness.

617. *We use here the small capital* ɪ for the long sound, and the dotted i for the short one. The elided *e* is sometimes represented by two dots. The *e* of de, le, se, we write with the vowel of *up* (perhaps incorrectly,) and using (ʊ) for it. For convenience in printing, we use o for the long and o for the short sound, § 412. A period point before an initial indicates a capital letter—capitals, however, are no part of language.

618, 619.

Calypso ne pouvait se consoler du départ d'Ulysse. Dans sa douleur,
cʌ˘lipsoˉ n.. pʊɫɛ s.. cŏ˕˘soˉlĕ dy˘ dĕpʌ˘r d.. .y˘lis. dʌ˘ sʌ˘ dʊlar (432,)

elle se trouvait malheureuse d'être immortelle. Sa grotte ne résonnait plus de son chant:
ɛl sʌ˘ trʊɫɛ mʌ˘lʊ˘rɑ˘ə d ə tr imortɛl. sʌ grot' nʊ˘ rĕɛo˘nɛ ply˘ d sŏ˕ ɾʌ˕˘:

les nymphes qui la servaient n'osaient lui parler. Elle se promenait souvent seule sur les
lɛ nɪ˕f ci lʌ sɛrɫɛ nɔɛ ly˘i pʌrlĕ. ɛl sʊ˘ prɔmnɛ sʊɫʌ˕ sʊ˘l sy˘r lɛ

gazons fleuris dont un printemps eternel bordait son ile.... Tout-a-coup ell apperçut les
gʌ˘ ə o˕ flʊ˘ri dŏ˕t ʊ˕ prɪ˕˘tʌ˕˘ə ĕtɛrnɛl bo˘rdɛ son ɪl.... tʊt ʌ˘ cʊ ɛl ʌ˘pɛrsy˘ lɛ

débris d'un navire qui venait de faire naufrage, des bancs de rameurs mis en pièces, des
dĕbri d ʊ˕˘ nʌ˘ɫɪr ci ɫnɛ d f ə r nɔ˘frʌ˘ʒ, dɛ bʌ˕˘ d rʌ˘mʊr miə ʌ˕˘ piĕs, de

rames écartées çà et là sur le sable, un gouvernail, un mât des cordages
rʌ˘mə ĕcʌ˘rte˘ sʌ˘ ĕ lʌ˘ sy˘r lʊ sʌ˘b°l, ʊ˕ gʊɫɛrnʌ˘ily (2520) 'a mʌ˘ dɛ cordʌ˘ʒ

flottant sur la côte
flɔ˘tʌ˕ sy˘r lʌ˘ cɔ˘t.

Translation, in French orthography, from two French Treatises on English.

620. Calypso koud not bi konfortĕd for thi dipartieur ov Youlysses. In heur grif shi filt [faound heursélf] eunhappy éte (§ 378) biing immortal. Heur groto no longhĕr rizaoundĕd ouith heur song. Thi nymphs hou sêrvĕd hĕr dêrd not spik tou heur. Shi ofĕn ouâkt alône on the flâouri (§129) teurf, ouith houitch én iternal spring côverĕd heur âiland. . . . . On é seuddĕn shi persivd thi fraghments of é véssĕl that had djeust binn

rékĕd, roërs béntchĕs brokĕn in pissĕs, ors skattĕrĕd hir énd thér on thi sand, é reuddĕr, é mast énd kordédje floting on thi shôre.—*P. Y. de Séprès.*

621. *The next is based on Rapp's* example (3, 141–2,) from Molière's Tartuffe, act 1, sc. 6, the orthography of the original being our own.

Instruit par son garçon qui dans tout l'imitait
ɹ˵stry˘i pʌr so˵ gʌrso˵ ci dʌ˵ tʊ limitɛ

et de son indigence et de ce qu'il était,
ĕ d so˵ ɹ˵dijʌ˵s e dʊ s c il ĕtɛ,

je lui fesait des dons mais avec modestie
jʊ ly˘i fəɛ dɛ do˵ mɛ (2 389) ʌɛɛc modɛsti

il me voulait toujours en rendre une partie.
il mʊ ɛʊlɛ tʊjur ʌ˵ rʌ˵dr y˘n pʌ˘rtɪ.

c'est trop, me disait-il, c'est trop de la moitié,
s ɛ tro mʊ diəɛt il, s ɛ tro d lʌ mẏʌtiĕ,

je ne mérite pas de vous faire pitié.
jʊ n mĕrit pʌ˘ dʊ ɛʊ fɛr pitiĕ

et quand je refusais de le vouloir reprendre,
e cʌ˵ jʊ rfy˘əɛ dʊ l ɛʊlẏʌr rprʌ˵dr

aux pauvres, à mes yeux, il allait le répandre.
o˘ po˘ɛr, ʌ˘ mɛ jʊ˘ il ʌlɛ lʊ rĕpʌ˵dr

enfin le ciel chez moi me le fit retirer
ɹ˵fɹ˵ lʊ sjɛl ɾe˘ mẏʌ mʊ l fi rtirē

et depuis ce tems là tout semble y prospérer.
ĕ dʊpy˘i s tʌ˵ lʌ˘ tʊ sʌ˵bl i prospĕrē.

622. *Both Rapp and Ellis* write French nasal *in* ··on the basis of the vowel of *ebb*, the Polish e˵ in pjɛ˵to (five,) which is concurrent with ɹ˵ ··in Wyandot. Here the practice of Mr. Ellis is based upon French opinion rather than upon his own ear, as he has informed us.

623. *Most of the succeeding examples* were taken before we had distinguished ə from ʊ, and the open u from the close ʊ, so that the one may often stand for the other.

CHEROKEE.

624. *The Lord's Prayer*, the native version. Read ɑ in *fall*, ɪ in *pit*, ʊ close and short, in *up*.

[1] ɑci·tɑtá	[2] cǎlʊ˵látʊ˘	[3] hehɪ́	[4] calʊ˵cʊ̆ʊ̆tʊ̆jʊ˵́	[5] cɛsētɪ́	[6] te·tsǎtɑʊ˵ɪ́.
our-father	(in) heaven	who dwellst	honored	be	thy name,

[7] tsǎcʊ˵vɪjuhɪ́	[8] cɛsʊ˵́	[9] vɪ˘cǎnǎnʊ˘cɑɪ.	[10] ǎ́ɪnɪ́	[11] ĕlɑhɪ́	[12] vɪnɪcǎ˝lɪ˵stá	[13] hǎtǎnńte·scʊ˵·ɪ́
thou-king	being	let-appear.	here		let be done	thy will

[14] nähsci·já [15] cälv̥ˬlätı′ [16] tsın˘cä″lı̥sti·há. [17] nĭtätɑtv̆˘cvĭsv̥ˏ′ [18] ɑcä″lı̥stäɹ v̥ˏtı′
as it is (in) heaven done. daily our food

[19] scĭv̥ˏsı′ [20] cɑhı′ [21] i·cá. [22] tĭcèscĭv̥ˏ˘sıcvo·nd̆ˏ′ [23] te·scı·tu·cv·ı′ [24] nahscījá [25] tsıtícajɑ̃tsīñnēhɑ̃,
give us this day. and forgive us our debts (14) as we forgive

[26] tsɑtsĭtucı′, [27] alé [28] cle|stı′ [29] ʊ˘tăcɒ˘lĭjɛ tijı′ [30] vıthscījätınv̥ˏ|stanv̥ˏcı′,
those who owe us, and not in the way of trial lead us,

[31] sciju·talésces tıcvo·scını′ [32] ʊjɑ̃ [33] cɛsv̥ˏ·ı′. [34] tsv̥˘stsēlıcăbjɛ·nd̆′ [35] tsv̥cv̥ˏ·vtju·hı′ [36] cɛsv̥ˏ·ı′
but deliver us from (the) evil that is. for thine king (33) being.is

[37] tsä″llĭni·cĭtı′ [38] älé [39] cɛsv̥ˏı′ [40] e·tsvlv̥ˏ·c″vti·jʊ′ [41] ále [42] cɛsv̥ˏ· [43] mıcɑhĭlv̥ˏ·ı′ [44] näscı′
strong and the-being honored and the-being always so

[45] vıntá″lstá.
(12) let it be.

625. This is the pronunciation and rendering of the Rev. Stephen Foreman, a native. The final of [9], [33], &c. is *not* a coalescent. The accent in [2] may be erroneous—see [15]. The final of [37] is probably ı. It seems ([16], [44],) that flat **t**, **c**, do not associate with *s*.

626. The whispered vowel in [12], [16], [18], should probably be omitted as an error of the alphabet (§ 589,) as in No. [45]. The vowel v in [18] is nasal, and whispered, being between surds. The final syllable of [22] means *and*, like Latin -QVE.

627. The final syllable of [30] would be omitted if not followed by a stop; and if [32] ended the sentence (the verb in the three last letters of [33] being implied, or given in another place,) it would have a final accented ı. This peculiarity appears in [39] and [42]. In [34] the final hjɛnd̆′ means *for;* and in [26] tsɑ means *those.*

628. We have taken but one liberty with our manuscript, namely, in making [24] correspond with [14] on the authority of the version in Gouraud. We had written [24] "naskijá," failing to catch the *h* heard in [14] (if it was sounded,) and also the flat sound of *cay*. At that period we used *k*, and a dot above for the short quantity, a good enough mode, but difficult to print.

WYANDOT (=VƆNDƆT.)

629. *The Lord's Prayer*, the notation the same as the preceding.

scvv̆˘ɔ̀ıstıˏ [2] jăvɔ̀ˏnɹˏă˘ɔ̀jɛ [3] ıχstàvɛ˘ˏ; [4] tʊjɛ́ˏhtı [5] de [6] ɾɛɾɛ̀ndă˘ˏ; [7] tu·tăvè
our father heaven.....in thou-inhabitest righteous thy name. let-it-come

[8] savɔ̀ˏnjămɛh. [9] ăvătvìvajvıtı′ [10] dɛ [11] savìvd̆˘ˏ [12] o·mɛ̀tsă˘ɔ̀jɛ [13] tijʊ′htı [14] de
your heaven. let-it-be-accomplisht thy purpose earth.....on like-as . .

[15] jărò.nJ.ă>ăjɛ. [16] tăva·nó.t [17] dă>ătĕmé.ntăjɛ [18] măcjă>ătàndiţăhcvɪ. [19] sɛsɛ>ădìjŏ.r.h.ɛ.
heaven.....in. give-to-us every-day ... our-sustenance. forget-thou

[20] dɛ [21] sɛri·jɛ'>ăcŏ.ndɪh [22] tijɛvárrĕhă> [23] dʊ [24] nJ.o.'mɛ'>ɛ˘ [25] o.-cirijɛ'>ăcŏ.ndɪh.
... our breaking thy laws as we do our own law breakers.

[26] tăvò'hsărit [27] to.>o.mɛ'h [28] dɪ [29] stx.>ɛ˘h [30] tă>ătănJo.'mɛ˘htràtɛ˘t [31] dʊca·ʊ'ht,
lead us that way ... not to be beset (by) evil,

[32] sɛmx'.h [33] dɛ [34] jărò.nJ.ă>ăjɛ [35] dɛ [36] ja·vɪ'hrră>' [37] tu·ndɪ' [38] du ra·mé>'.
thine ... (the) heaven and (the) power and-likewise the glory.

630. This version was composed in our presence (we writing it down) by the intelligent native chief of the Wyandots, J. M. Armstrong. Wyandot is an Iroquois language, and the three first words of the preceding version correspond with the four—

"Songwaniha ne karonghyàge tighsìderon,"

as given in the Mohawk 'Common Prayer,' London, 1787, p. 53. Zeisberger gives garochia as the word for *heaven*, in the Onondago dialect. No. [4, 8, 13,] &c., have the common *h*. The *o* seems to be always nasal, and in number [12] it is probably erroneous.

631. The elements in the language are—i, ɪ, e, ɛ, x, ɐ, a, ɒ, o, u, ʊ,—v, m, (no other labials,)—n, d, t, t, (no *l*,)—r smooth, s, (no *z*,) r, J,—j, G, c, c, χ, h, >, besides nasal vowels. ʊ is used for a short sound without discriminating it from ŭ, (§ 623.)

632. ʊ>ʊcjerɪ˘h.ɛ. dʊ'>ʊndă>'. ʊ'>ʊndă>' JʊJ'>ʊJ.ɛ>' vɒ'tx˘J.ŏ. hɛ˘nda·rɛ́>'.
it is straight the-arrow. arrow. §486. ground-squirrel in-a-hole lives.

GJá>ără, Niagara, probably from cJá>ăcŏ.>, broken. scʊ'>ʊtă, head. cvɛnJʊ>ʊtă, cicada. Jʊ>', pigeon. tsa>andʊ˘scɛ, Sandusky (=at the waters.) xlɪcèsɪ, Allegany. ajndă>', bow. hntrɪ·rɔ́, rakoon. Jɛntsó, fish. cvésɛ.>', fowl. hòtă>', ear, which some may consider akin to *οὖς*, *ὠτός*. nJ.ɒ.tɛ·rʊ>', my friend.

NADACO.

633. *One of the peculiarities* of the Nadàco or 'An-a-dah-has' has been alluded to in § 448. Another is the occurrence of the vowel u or ʊ, the Latin consonant v, and the allied coalescent ·v; also, ɪ, ɪ, ·j, J. We heard a man call a finger-ring nacè˘sɛmbe˘-ca˘sɛ.˘,* whilst his wife called it nacèssɛmbetrahasɛ, with an additional syllable *ha*. See the word for finger. The vowel of *add* occurs here, and a final vowel is often whispered, as in eight of the following examples.

* Although we use (') for short accented syllables, and (') for long ones, the accentual leaning towards the co-accented consonant, yet when we use (˘) together, as in this place, the syllable is to be considered as made of cè˘ and not of é˘s,—and é˘s might occur also.

dasòto *crown*
tɾóhŏtŏ, *hair*
tsăhătàʊ, *forehead*
táncădăʊs (not taʃ-) *cheek*
bɪɾtʊ, *ear*
tsáhaˈv, *eye*
tɾăbèhetaˈv, *brow*
sŏŏ, *nose*
tăměso, *jaw*
ădètọ *tongue*
ătè˘tọ, *warm*
vácŏhŏ, *chin*
nătsèŏ, *neck*
bĕhĕdáˈvsŏ, *shoulder*
nánɛh, *clavicle*
coˈɾ, *heart*
coˈs, *breast*
tsòtŏ, *nipple*
sɛntŏ˘họ, *wrist*
sècŏ, *palm*
sɛmbɛ́to, *finger*
sɛmbɛsàs, *thumb*
băsóhŏtŏ, *leg*
biŏcŏ, *knee*
năhătŏh, *ankle*
nʌˈsŏ, *foot*
năhcăháˈv, *sole*
năstsŏtŏ, *heel*
náʊctọ, *toe*
nátɪ, *woman*
tánăcɪs, *leech*
tʌˈnăt˘, *gryllus*
ētɾʌˈt˘, *toad*
cáhsɛn, *coat*
cántăsŏ, *leggins*
conaˈvtăʃcŏ, *hatchet*
nʊcĕcahăvă, *pipe*
năcímpɪ, *beads*
tápɛt˘, *fan*
vàɪ, *shoe*
sàˈhaˈv, *house*
căntáibẹ, *mirror*
còcɛ, *water*
vàtʊt˘, *ground*
acò˘hŏtŏ, *cold*
hà˘hăt˘, *good.*

KANSA (=cɔnɛɔ.)

634. *The vowel* Y, French *u*, is found here, although very rare in the aboriginal languages of North America. In our examples we add (in parentheses) the Dacòta equivalents, but placing Riggs' diacrits *after* instead of over the letters, as g· (which is compared with ghain,) s′, English *sh;* h·, 'a deep surd guttural;' c′, Eng. *tsh;* z′ Eng. *dzh; n,* as in English *sing,* and French *bon,* the two being confounded after eighteen years study by a number of missionaries. Probably both sounds occur, as in Kansa.

ear,	nɛtá (nog·e)	*forehead,*	pĭèsɛsɛ (ité)
eye,	ɪɾtátɛ˘ʃɛ˘ (is´tá)	*fan,*	ĭcīlăɟɛ (ic´ádu)
brow,	ɟɾtáhɪɾăbă (is´táh·e, *eye-ridge.*)	*pipe,*	nŏnóbă (c´*an*dúhupa, c´*an*dí, tobacco.)
mouth,	ìhă (i)	*knife,*	mòhɛ (mi*nn*á)
tongue,	ɟéssɛ* (c´ez´í)	*warm,*	mɛɾtjèaˈv
nose,	pɴh* (póg·e)	*leggins,*	hy˘ʃɢă (hu*n*ská)
nostril,	pɴɾʊˈɾɛ (póg·e-oh·dóka, nose-hole.)	*shirt,*	ɔscɔ´scŏʊcɟdo.cʊdă (*on*-h·doh·da.)

* Pronounce each *s*, and the *h*.

CHIPPEWAY. (ŏtɾɪbvè, pl. otɾɪbvèɢ.)

635. nɛ.nɛpàtɾɪnɪcɛ˘sɪ′, the *mole,* being ɪnɪc for ŏnɪc, an arm, his arm (nɪnɪc my arm, cɪnɪc thy arm,) nɛ.pàtɾ, wrong, left, opposite; nɛ- its reduplication, for both arms; ɛ s ɪ′, a noun suffix of the animate gender. The mole then, in the view of a Chippeway, is the

animal with reversed arms, the right one being apparently on the left shoulder, because the palms, instead of facing each other, are exterior.

636. pɛjɪgōgʊjì, the *horse*. For pɛjɪgoɾgʊjī; from pɛjɪ'g *one*, ŏɾcʊ'ʒ *hoof*, nail; the *single-hoofed*, or solidungular animal, this being its zoological characteristic, and one which very few Europeans would have observed. How few, for example, who have seen the gnu (=black,) and the camel, can tell whether the feet are solid or cleft. The Chippeways name an elephant, not from its trunk, but from its straight or columnar legs; and a sheep from its 'ugly hair,' the wool striking their attention unfavourably. In Bishop Baraga's Dictionary of the Otshipwe Language, Cincinnati, 1853, the word for *horse* (bebejigoganji,) has a initial reduplication, like that for *mole*. In Choctaw, a horse is ɪ'sŏbă, from ɪ'sɪ *deer*, hʊ'lbă *resemblance*. In Nadaco, it is the Mexican Spanish că'bajŏ, which varies to cavàrʊ* (Eng. *w*, trilled r,) in Waco. Similarly, in Penobscot (here *t* for tʊc''v means *river*, compare Aroostook,) the English name with its article, appear as ʊ.hŏ.s; and aháhsʊ, and a buffalo as bábʊlŏ.

637. mɪn (mīn, ɪ being used for ī,) huckleberry, pl. mɪnʊn, mɪ.nè.s, thorn-apple, Datura stramonium; ɛs, dimin. mɪnɪ' a round sore, mɪnɪ's an island, mɪɾɪmɪ'n, apple, (great berry,) written *mishimin* by Baraga, mɪtɪ'gvɑb, a bow, because difficult, (gvɑb,) to draw or bend; nɪn vɑb, nɪvɑb, I see; vɑbʊɾc, to-morrow (the time of being light,) vɪgɪvɑm, a *hut*, from sheltering, in Lɛnāpɛ—vɪcvŏm.

638. The *muskalonge* or great pike of the lakes, is in Chippeway mŏɾcɪnō.jɛ, from mŏɾ-*great*, (compare Mich-igan, Missi-sippi,) cɪnō.jɛ̀, *pike*, and cɪnʊ'ɾcɪjì is any long-snounted animal, as a hog. Compare *pig* and *peak*, *pike*. vʊ'jʊ'ɾc, muskrat, ʊjʊɾcɪ', mud. aɾcɪbvŏcɑ'n, (place of artichokes,) Cheboygan, the orthography of which is French. mʊɾcìg, swamp, whence Maskegon. mɪɾɪ'-sɪbɪ' great river. atɾɪtămō., the red squirrel, Sciurus hudsonius, because it descends trees head foremost. asʊ'nʊ.gō, grey squirrel, that sticks fast, or close, (to a limb)

639. *The polysynthetic structure* of the Vesperian languages is widely spread. In Aztec, according to Humboldt (Vues des Cordillères, p. 316,) a *kiss* is *tetennamiquilizlli*, and *pain* is *tetlayhiouiltiliztli*. Condamine (Pinkerton, xiv. 225) thus speaks of the *Tameos* of South America. "The language of this people is indescribably difficult, and their enunciation still more extraordinary than their language. They draw their breath in speaking in such a manner that the sound of scarcely one vowel can be distinguished. They have words which, to describe, and then but imperfectly, would require at least nine or ten syllables, though, as pronounced by them, they seem to consist of but three or four.

* These forms are sufficiently like the West African Grèbo cóbósō (horse,) to suggest an identity of origin. But this is from cŏ (to die,) in this manner. The peculiarity of the white race in Africa is to *die* in a short time, hence cŏbŏ *dying kind*, is the word for a white man; sō is *lizard*, so that a horse is considered the 'white man's lizard.'

Poettarorincouroac, signifies the number *three* in this tongue: happily for those who have transactions with them, their arithmetic goes no farther."*

640. Pitchlin, the intelligent chief of the Choctaws, gave us the etymology of the Choctaw (=trð'tð†) word ĭð'nubı (iron-wood, Ostrya virginica.) It is for ıɛ'nɛrtɐ,bı (with all the syllables short, the third with the secondary accent,) contracted from ıɛnɛrırtɐbı, *that with which kill buffalo*, (as a club, arrow, &c.,) their bows being made of this wood. ıɛ'nɛr *buffalo;* ırt *that with which;* ɐ'bı *kill.*

GREEK.

641. mɛ̂nin ´á|ɛjdɛ ϑɛ|à pɛ|lɛíá|dɛ'o ăχi|lɛ̂ōs
ŏ'vlŏmɛ́|nɛn, hɛ̀| mȳrí.. ă|χajôjs | álgɛ¨ ɛ́|ϑɛ cɛ.—*Iliad*, I. 1, 2.

The next is from *Corinthians* xiii. 1, 2, being the passage transliterated by Mr. Ellis. We preserve the accents, ϑ, and χ.

642. ɛằn tâjs glōssajs tôn anϑrō'pōn lălô càj tôn aſgɛ̀lōn, ăgápɛn dɛ̀ mɛ̀ ɛ'χō, gɛ́gŏnă χalcŏ's ɛχôn, ɛ̀cy'mbălŏn ălăláəðŏn.—càj ɛằn ɛ'χô pro'pɛtɛ'jăn, càj ɛjdô tằ, mystɛ'riă pă'ntă, càj pâsăn tɛ̀n gnôsin; càj ɛằn ɛ'χō pâsăn tɛ̀n pístin hō'stɛ ŏ'rɛ mɛϑistánɛjn, ăgápɛn dɛ̀ mɛ̀ ɛ'χō, ŏ'vϑɛn ɛjmi.

ITALIAN.

THE LORD'S PRAYER.‡

643. pàdrĕ nostrω˘ cĕ sèĭ nèĭ trĭɛ̀lĭ, sìă santificàtω˘ ĭl nὼmĕ tùω˘, ʟɛ́ſgă ĭl rènyεω˘ tùω˘; sìă fáttă lă ʟω˘lω˘ntá tùă cὼmĕ ĭn trĭɛ̀lω˘ cωsí ĭn tɛ́rrā; dáttrĭ [give thou] oddjĭ ĭl nostrω pànĕ cvω˘tĭdĭànω˘, ɛ rĭméttĭ ă nὼĭ ĭ no̅strĭ débĭtĭ sĭccὼme nὼĭ lĭ [for them, *accus.*] rĭmĕttĭàmω à no̅strĭ dɛbĭtω̅rĭ, ɛ nω˘n trε [us] ĭndúrrĕ ĭn tɛntátsĭὼnĕ mā líbĕrătrĭ [-trĭ, us] d.. ăl màlĕ. ɛ cωsí sìă. (*âmɛn.*)

LATIN.

THE LORD'S PRAYER.

644. pátĕr nòstĕr cvī ĕs ĭn còjlīs; sā̆ſctĭfĭcētŭr nòmĕn tŭū. a·dvénĭăt règnū. túū. fìăt vŏlùntās túă, sìcŭt ĭn còjlo, ĕt ĭn tèrrā. panē. nòstrū. sŭpe·rsu·bstāntĭàlē. [cvōtĭdĭànū.] dā nòbīs hódĭē. ĕt dīmìttĕ nòbīs dèbĭtă nòstră, sìcŭt ĕt nōs dīmìttĭmŭs dēbĭtòrĭbŭs nòstrīs.

* "The sounds of the 'Tinnè language can scarcely be expressed by the English alphabet, and several of them are absolutely unpronounceable by an Englishman. In my attempts to form a vocabulary, I had great difficulty in distinguishing several words from one another which had dissimilar sounds to the native ear, and were widely different in their signification. A Dog-rib or Athabascan appears, to one unaccustomed to hear the language, to be stuttering. [§ 551.] Some of the sounds must have a strong resemblance to the Hottentot cluck, and palatal and guttural syllables abound in the language. Vocabularies of this tongue cannot be greatly depended upon, as no two people will agree on the orthography."—*Richardson*, Arctic Searching Expedition, chap. xiii.

† This word cannot be spelt with the English alphabet, although every element is English, the vowel being that of *odd*, as in Kansa (=cð'nɛð.)

‡ As pronounced by Mr. P. L. Rosteri, instructor in Italian at Florence.

ĕt nē nōs i·ndùcās ĭn tēntātĭònē, sĕd lìbĕrā nōs ā málō. nā, túū, e·st règnū, ĕt i·mpérĭū, ĕt māgnĭfĭcèntĭă, ĭn sēmpĭtèrnō.—*Gouraud*, pl. 12.

645. *Our variations from the Latin text* are due to the inconsistencies of Latin orthography in the use of Q, M, U, X,—and E both as a coalescent and a vowel. In several cases we mark length 'by position,' where the vowel is naturally short, by (·). We omit the coalescent dots, and write aj, oj, for æ, œ.

VIRGIL.

646. *In the following example*, the first and fourth feet of the first line must have no accent, because the verse has the rhythm of time, the ear being informed by the accent of the fifth and sixth feet, that the measure is hexameter. Vūlnŭs, at the end of the third line, has its time made up by the consonant at the beginning of the next line, or by a comma point. Aeneid, I, 34, 35, 36, 220.

vĭcs	e	cōnspèct	u	sícu	laj	tell	ùris	in	àltu,		
scārce	wēre	thēy	frèe	frōm	sícĭ	lȳs	shōre	oùt	ĭn	thĕ	high sea
vèla dá	bant	làjt	ı	et	spù	mās	sálĭs	àjre	ru	èbant—	
saìlĭng	ín	tō	white-	capt	wàves		thēir	métal	pàrtĭng	the	wàters,
cum jùn..	ajtèr	nu^{m}	sèrv	ans sub	pèctore	vùlnŭs—					
whēn	jù	no	àl	wāys	hòld	ing hēr	woùnd in	re	mèmbrance—		
prajcípŭ	ē	píŭs	ajnè	ās nū/c	àcrĭs	ŏ	ròntej—l. 220.				
now chiefly	the	pious	æne	as the	fate of the	active, &c.					

647. *The false 'hexameters'* of Southey, Longfellow, and others, together with our accentual music, crush the rhythmic sense which Latin verse should have fostered, and gives us the barbarous relish for the rhythm of noise which rustics exhibit when they think their step in the dance should be heard as well as seen and felt;—the dance (the ancient *chorus*) being the only rhythm of time we are acquainted with.

648. *The last Latin line*, therefore, strikes the modern ear as a five-foot measure of *English* amphibrachs—

now chíefly	the píous	enéas,	the fáte of	the áctive
oróntes	and álso	of ámyc	and ly'cus	bemóans him—

or like the next, in *English* dactyls—the normal form as recognised in our music—

. . . . .					now
chíefly the	píous e	néas, the	fáte of the	áctive o-	
róntes and	álso of	ámyc and	lýcus	be	moans him.

GREBO (§ 351*a*.)

649. *The Lord's Prayer* is given here from the dictation of a native, the translation being furnished by the Right Reverend John Payne, Episcopal Missionary at Cavalla. Nasal and stopt vowels (§ 350) are very common. Vowels unmarked, as to quantity, are *short*, and especially so when stopt. We have probable not marked all the stopt vowels.

ā bùa mð˘ₑ nɐₑ nɛ dɛ́ ɹū, naₑ' nɹₑe'nɛₑ' bɛ cɑ̃'-ʃnɛ, nɹₑĕₑ'bo'
our Father thou he art there heaven, thy name let it have holiness, men

bŏ nú' moₑ' va' cɩₑ', moₑ' naₑ' *ȣ̀rŏ' bɛ' nùₑɛ-dɛ́' cŭnð'' mðₑ'
they must make thee their king, for thy mind (will) let it be-done-here world in

tɛnɛ́ₑ o' nĭ-dɛ́' nɛₑ ɹù, hₑɹₑɩₑ āmóₑ nɹₑɛₑnaₑɹĕdŏ' nɛ́'noₑ' ɛ'nɛₑdìba'dɛ́, neₑ
as they do-there it heaven, give us day this food, and

be' póₑ' āmóₑ' hₑvₑɩₑ'so'† co ā bonɛₑ cúcvi' a ta tɛnɛ́ₑ a nĭₑ'
do thou put us forgiveness for our conduct wicked its account as we do

ā pĕ nɹₑoₑnóₑ o' nĭₑ' amóₑ' bonɛₑ cùcvi' moₑ' hₑvₑɩₑso'† ɹɩ; ne naₑ
we put who-they they do us conduct wicked unto forgiveness also; and not

naₑɛₑ amóₑ' túdo'tú' ā tĭdɛ́ ɹīdí', ca' bɛ hā amóₑ' cū ɹɛ',
lead us temptation its way in, but (you) must take us devil from,

ɛmóₑ' mðₑ' teɹɛ́' cɩₑ' nɛₑ mð vɛ'-tē-ɹɛ́',‡ nĕ' mð mindₑ'' dɛ' bìɛ'
for thou art king and thou art-able-things, and thou shalt things all

ā nɹₑèₑnɛ cð'moₑ tī bìɛ', *amen.*
their glory have time all.

650. *In the following examples*, when the languages are not noted by parentheses, as in (*Armenian*,) we have taken them directly from the dictation of natives.

* This *ȣ* is perhaps nearer to *ooze* than to *awe*, §418. † The penult vowel is more open than *it*, or between this and *eight*. § 391*a*. ‡ te, things; jɛ for.

NUMERALS.

651. *Islandic.*	652. *Danish.*	653. *English.*	654. *Saxon.*	655. *German.*
1 ɛjtn	1 ɪn, ēn	1 vɛn, vðn†	1 əjn	1 ʌjns
2 t'bɛjr	2 tū, to·	2 tū	2 t'bəj	2 ts'bʌj
3 ʔrɪr	3 trɪ, tr̃ĕ, -ɪ	3 ʇrɪ	3 drʌj	3 drʌj
4 fíòrĭr	4 fìrə, fìr̃ɛ	4 fōɾ	4 fə̀·jərə	4 fɪr
5 fɪm	5 fɛm	5 fʌjɛ	5 fə'j'bə	5 fy˘nf
6 sɛ'cs	6 sɛcs	6 sɪcs	6 sʌsə	6 ɜɛcs
7 sɹʞ˘	7 sy˘ɛ, sɪɛ	7 sɛɛn	7 sì'bənə	7 ɜɪbən
8 á'vḥtă*	8 òtə, ótɛ	8 ĕt	8 áχtă	8 ʌ˘ć̆t
9 nìʞ	9 nɪ, nĭ	9 nʌjn	9 nìχənə	9 nə˘jn
10 tìʞ.	10 tɪ, tĭ.	10 tɛn.	10 tʌjnə.	10 tsēn.

656. *German.* (Westerwald.)	657. *Flemish.*	658. *Belgian.*	659. *Valais.* (Leukerbad.)	660. *Valais.* (Sitten.)
1 ēns	1 ì˘ɛn	1 ēn	1 ʌjs	1 ajs
2 ts'bē	2 t'bìɛ	2 t'bē‡	2 ts'bej	2 ts'bej
3 trɛ̃	3 drʌj	3 drɪ	3 drɪ	3 trɪ
4 fĕjr	4 ɛɪr	4 fɪr	4 fìrɪ	4 fìrĭ
5 fɪmpf, fʞ˘nf	5 ɛʌjf	5 fʌ˘jf	5 fìfɪ, fɪmfɪ	5 fùfĭ
6 sɛcs	6 ɜɛs	6 ɜɛs, sɛs	6 sɛ'cɹɪ	6 sɛ'cɹĭ§
7 sɪ'bə	7 ɜèɛn	7 ɜèɛɛn, sèɛɛn	7 sɪ'pnɪ	7 sɪ'bnĭ
8 oć̆t (§411.)	8 ać̆t	8 ać̆t	8 ðχtɪ	8 aχtĭ‖
9 nðj	9 neǵn	9 neǵɛn	9 nìpɪ	9 nìnĭ
10 tsè̤nə.	10 tɪn.	10 tɪn.	10 tsàχnɪ.	10 tsʌ·χnĭ.

*The slight *h* was denied by the speaker.

† Pronunciation of Mr. Kean, Princesses' Theatre, London, 1859.

‡ As we have used different notations at different times, we are uncertain whether we used '*w*' in our manuscript of this example, with its German or English power, and two grammars leave the question unsettled. *Fraai* (handsome)=frɑ̃j̇; *uit* (out)=ɛj̇t; *uil* (owl)=ɛj̇l; *hui* (whey)=hɛj̇; *houw* (a cut)=hðv̆; *hooi* (hay)=hōj̇. The Belgian *ui* we have heard in English; and in Swedish, nej (nay)=nɛj̇.

§ Feminine plural, sɛ'cɹo.

‖ Accusative singular, aχtu'ˌ.

661.	662.	663.	664.	665.
Suabian.	*Suabian.*	*Pennsylvania.*	*Russian.*	*Illyrian.*
(Schwartzwald.)	(Hohenzol. Hech.)			
1 ōˌəs *	1 oˌs	1 ens, eˌns	1 ădɩ'n	1 ɹɛ'dən
2 tsʿbōə	2 tsʿbōə	2 tsʿbē	2 dɛă	2 dɛð˘, dɛā
3 trùĭ, trī	3 trū	3 trʌj	3 trɪ	3 trɪ
4 fìrə, fìrɛ	4 fìrɩ	4 fɪr	4 trɛtìrɛ	4 trɛ'trɪ, trɛtìrĭ
5 fʌj.f, -ə	5 fʌj.fɩ	5 fɩnf	5 pɹɛtỹ	5 pēt, pɛtʿ
6 sɛ'csə, 7 sìbə	6 sɛ'csɩ	6 sɛcs	6 rɛstỹ	6 rɛst
7 sìʿbənə, -ɛ	7 sìʿbənɩ	7 sɩʿbə	7 sỹɛm	7 sɛ'dəm
8 ǎχtə	8 ɛ'χtɩ	8 ðʿct	8 ɹo'sỹɛm	8 ŏ'səm
9 nʌjnɛ	9 nʌjnɩ	9 nʌjn	9 dɹ éɹJătỹ	9 dɛ'ɹɛtʿ
10 tsenɛ.	10 tsènɩ.	10 tsèə.	10 dɹ ésỹ atỹ.	10 dɛ'sɛtʿ.

666.	667.	668.	669.	670.
Dalmatian.	*French.*	*Savoy.*	*Savoy.*	*Valais* at Sion.
1 ɹɛ'dăn	1 ʋ˘	1 ō˕	1 ʁ˘n, y˘n	1 o˕
2 dɛā	2 dʁ¯ § 430.	2 dū	2 dū	2 dū
3 trɪ	3 trʿvʌ˘	3 trē, trā	3 trej	3 trɛ
4 trɛ'tĭrĭ	4 cʌ˘tʿʿr	4 cʌ˘t	4 càtro	4 càtro
5 pējt.	5 sɹ˕ʿcʿ	5 rɹ˘	5 sĭʃc	5 sɹ˕
6 rēs	6 sĭs	6 rɪ	6 sējs	6 sɪs
7 sɛ'dăm	7 sɛtʿ (sɛtʿ)	7 sʌ˘	7 rɛtʿ	7 sătʿ
8 osăm	8 y˘rʿt	8 vɪ	8 vɪt	8 vɛt
9 déɹɛt	9 nʁ˘f § 431.	9 nʌ¯	9 nū	9 nū
10 dɛ'ssɩ¯t.	10 dĭs.	10 dʌ˘.	10 dɪs.	10 dɹʁ.

* Compare Allemanic (Bodensee, Aarau,) hùət, *hat;* fùəs, *foot;* flìəgə, *to fly;* lùəgə, *to look;* lùəgt, *looked;* ìʿbəl, *evil.*

671. *Lyons.*	672. *Marseilles.* (Provensal.)	673. *Narbonne.*	674. *Bearnais,* (of Pau.)	675. *Spanish.*
[1] jōn	[1] ìəʃ, ĭʊʃ	[1] yn, yən	[1] yˇn	[1] ùnŏ
[2] dū	[2] dos, dʊs	[2] dūs	[2] dyˇs	[2] dŏs
[3] trʌj	[3] trĕs	[3] trēs	[3] trĕs	[3] trĕs, trɛs
[4] càtro	[4] càtrɛ	[4] càtrɛ	[4] cvàtrɛ	[4] cvàtro
[5] ʔʌj	[5] sɪʃc, sɛʃ	[5] sĭɛʃc	[5] ɾɪʃc	[5] ʔɪʃco
[6] sʌɪ	[6] sìē	[6] sĭēs	[6] rēj	[6] sējs
[7] sʌ	[7] sɛt, sɛ	[7] sɛt	[7] sɛt	[7] sĭɛ́tĕ
[8] vɪ¯	[8] jy`ɛ, ʟʊɛ′	[8] bɛjt	[8] vējt	[8] òtrŏ
[9] nʜ	[9] nō·v, nō	[9] no·v	[9] nā·v	[9] nʊɛ́ʟĕ, nʊɛ`ʟɛ
[10] dʜ¯.	[10] dɪ̣ɛ`s, dɛs.	[10] dɛts, [12] dʊtsɛ.	[10] dɛts.	[10] díɛʔ.

676. *Catalonian.*	677. *Portuguese.*	678. *Wallachian.*	679. *Armenian.*	680. (*Armenian.*)
[1] ūn	[1] ụ̄m	[1] ùnŭ	[1] mɛG	[1] mɪ
[2] dos	[2] dùɛɾ	[2] dój	[2] jɛr,GU′	[2] JérGu·
[3] trɛs	[3] trɛ̀ɾ	[3] trej	[3] jɛrĭɛ́c	[3] Jérɛc
[4] cvàtrɛ	[4] cvʌtrŏ	[4] pàtrŭ	[4] trʊŏrs, trvŏrs	[4] trðˇrs
[5] ɾíʃcvɛ	[5] sɪ′ʃcŏ	[5] trĭntr	[5] hĭʃc	[5] hʊˇnc′
[6] sɪs	[6] sɛ̣jr	[6] ʿrɛsɛ̣	[6] ʿbJɛts, ɢĭɛts	[6] ʟɛts
[7] sɛt	[7] sɛtɛ	[7] rɛ`ptɟɛ̣	[7] jòtən, -tn	[7] JótN
[8] bʊjt	[8] vìtŏ	[8] ŏpt′	[8] ùtən, -tn	[8] ʊt, ʊtn
[9] nō·v	[9] n`oʟɛ	[9] novɛ̣	[9] ìnən	[9] ìnən
[10] dɛ·v.	[10] dɛɾ.	[10] ɜɛ`trɛ̣.*	[10] dàsn.	[10] dY`sn.

* [11] ùnspreɜɛtrɛ, where *spr* is for *super*.

681.	682.	683.	684.	685.
Turkish.	*Hungarian.*	*Albanian.*	*Ellenic.*	*Arabic.*
1 bĭɾ	1 ɛdj̊	1 nɟ̆	1 ɛ̀nă	1 vʌhɛt,—d.
2 ĭcí	2 cɛ́ttɤ̄	2 dy̆	2 ɑìŏ	2 ĭʔnʌjn
3 y̆tɾ	3 hàrom, o?	3 trɛ̆	3 trìă	3 ʔʌ̆lʌ̄ʔʌ́t
4 duĭrt	4 nēdj̊	4 càtr	4 tɛ́sără, tɛ́sɛră	4 ʌ̆rbʌ̆ʌ̣t
5 bɛɾ	5 ɤt	5 pɛ̣s	5 pɛ́ndɛ	5 ʿqʌ́msɤt †
6 altɤ́	6 hot	6 djăɾt*	6 ɛ́csɛ, ɛ́csĭ	6 sĭttʌt
7 ɟɛdì	7 hejt	7 ɾtăt*	7 ɛptá	7 sʌ́bʌ̣t
8 sɛcìs	8 nɟŏlts	8 tɛt	8 óctŏ, octó, ɔɛtó	8 ʔʌmʌ̀nɟɤt,*‡
9 docús	9 cìlɛnts	9 nănd^{t}	9 ɛǹɛ ă, ɛnɟá	9 tísʌ̣̄t
10 on.	10 tɪɛ.	10 ɑɛt.	10 ɑɛ̀că.	10 ʌ̣́ɾrʌ̆t.

686.	687.	688.	689.	690.
Chaldee.	*Syriac.*	*Coptic.**	*Welsh.*	*Irish.*
1 hɑă	1 hɑo	1 ŭvàĭ	1 ɩn, ɪn.	1 hèɤn
2 trɛn	2 trɪn	2 snà·v	2 dɔj	2 d̲ō
3 tlàʔă	3 tlòʔŏ	3 ɾɤmt	3 trɪ	3 t̲rɪ
4 árbạ	4 árbŏ	4 ftòŭ	4 pɛ́dvăr	4 cɤ́hɤ̆r
5 hámɾă	5 hámɾŏ	5 tìŭ	5 pɪmp	5 cùɪɢ, cūdʒ
6 ɪ́ɾtă	6 ɪɾtŏ	6 sòŭ	6 ʿvvē'c‡	6 ɾē
7 ɾàŭạ	7 ɾàŭọ	7 ɾɛɾf†	7 sʌjɔ	7 ɾɔ́ɔ́t
8 tmánjá	8 tmánjŏ	8 ɾmɪn	8 vɪʔ	8 ɔ́ɔ́ɔt
9 tírạ	9 tɪ́ɾŏ	9 psɪt	9 nʌ·v	9 n̲ē
10 ə́sră.	10 ə́srŏ.	10 mɛt.	10 dēɢ.	10 d̲ɛ.

* This 'ɾ' is between *s* and *sh*. † 'ɤ' between ɤ, ɛ. ‡ Vulg. ʒəmʌnɟɛ.

* Memphitic (jacobite,) pronounced by one having an Arabic vernacular. The fem. form of [1] is ùvĭ, of [2] snùtĭ (or *d*,) and of [9] psìtĭ.

† In our MS. this ɛ has the note "towards *a* in *fat*," which, if correct, will locate it between these sounds, and close the blank under ɤ in § 369.

‡ An initial 'c is lost here.

691. (*Persian.**)	692. *Coordish.*	693. *Gudzhràt'hi.*	694. *Hindustani.*	695. *Bengali,* (Calcutta.)
1 ɟɛc	1 ɟɛc	1 ɛc̊†	1 ɛc	1 ɛc̊
2 dy˘	2 dʊ˘dʊ´	2 bɛ	2 dū, dō	2 do˘ĭ
3 sɪ	3 sɪsé, ɪ?	3 tɐn	3 tĭn	3 tīn
4 tɾáhar, tɾăr	4 tɾār	4 tɾă𝑥,	4 tɾār	4 tɾàrĭ
5 pɛntɾ	5 pendɟ	5 pănt ɾ	5 pā˛tɾ	5 pà˛tɾ
6 ɾɛɾ	6 ɾɛɾ	6 tɾɐ˘	6 tɾhov‡	6 tɾɑ˘ɛ §
7 hɛft	7 ʎăft	7 sāt̊	7 sāt	7 sāt
8 hɛɾt	8 ʎăht	8 āth	8 āt	8 āth
9 nyχ	9 năh	9 nɐɹ, nɐ˙vɹ	9 no˙v‡	9 nɑ˘ɛ §
10 dɛχ.	10 dăh.	10 dɐs.	10 dɐs.	10 doɾ.

696. *Tamil.*	697. *Cherokee.*	698. *Creek.*	699. *Choctaw.*	700. *Iroquois.*
1 vɐ´nɐ˛	1 sĕcvó	1 hɐ'mcɪn	1 tɾɐ˘fɐ'	1 ɐ'scɐ
2 rɛ́ndu	2 tăli'	2 hocòlɪn	2 tʊclʊ'	2 tɛ́cɪn
3 mònɐ˛	3 tsɑɪ'	3 tʊtsìnɪn	3 tʊtɾĭnɐ'	3 háhsɐ
4 nàly,* y?	4 nɐ˛cɪ'	4 òstɪn	4 ʊɾtó	4 căjèḷĭ
5 ándɟi	5 hɪscɪ'	5 tsáχcɪpɪn	5 tɐ˘ᵒLlăpɪ'	5 ʊɪsch (c'h)
6 àrʊ˘	6 sʊta·lɪ'	6 pàcɪn	6 hɐ˘nălɪ'	6 jàɟɐch (c'h)
7 ɟéry¯*	7 cɐ˘ LcvōcɪI'	7 cʊlăpàcɪn	7 ʊ˛tʊclʊ' (2)	7 tsàtɐ
8 ɟéty¯*	8 tsʊnɛ·lɐ'	8 tɾɪnăpàcɪn	8 ʊ˛tʊtɾe·ná (3)	8 satècʊ˛
9 vɔ̄nbɛɑy¯*	9 sɔne·lɐ'	9 ʊstăpàcɪn	9 tɾɐ˘ca·lɪ'	9 jŏhtŏ˛
10 páty¯*	10 scɑhɪ'	10 pàlɪn	10 pʊco·lɪ'	10 ujèlĭ (2421)

* From the dictation of an Armenian. † ɛ towards ɪ. ‡ o towards ɐ. § The genuine ɑ in *fall.*
|| This *y* seems to lie between y and ʊ.

701.	702.	703.	704.	705.
Wyandot.	*Comanche.*	*Nadaco.*	*Waco.*	*Lenàpe.*
1 scʊt	1 sɛ́mmʊs	1 vɪ'stsɪ	1 tɾè˘ɒs	1 cvɐ'tɪ
2 tɛndɪ'	2 vhă	2 bɪth (t'h)	2 vɪtɾ	2 níɾă
3 ɾɛ˛'hc	3 păhăχt'	3 dăhá:v	3 ta·v"	3 nɐ˘χ˘ɐ'
4 ṇdɒχc	4 vɒ'·χtsʊχt'	4 djévĕ	4 tàcvɪtɾ	4 nʌvá
5 ʊvɪ'ɾ	5 mánʊcht' (c'h)	5 dèsĕcăt'	5 ɪscvèto (§ 490)	5 pʌlènɐχ˘c'
6 uva·ɟ	6 nà"văχt'	6 dáſcɪ	6 cì·ăhʌɔ	6 cvɐ'ta·ɾ
7 tsʊtɒvé ▷'	7 tàtsʊχt'	7 bɪ'sɪch	7 ciùă˘vɪtɾ	7 niɾa·ɾ
8 tɛvé ▷'	8 ná'bĕvɒχtsʊχt' (4)	8 dá:vsɛc'	8 ciátă:vh (see 3)	8 χ˘a·ɾ
9 tró˛ ▷'	9 sé·˛vɒnɐvʊhnʊt'	9 ívĕsɛc'	9 tsiɐscɪ'ntĕ	9 pèɾcu·ſc'
10 ăsé˛h, sɛ˛h	10 sé·˛vɒnɐhʊt'	10 bɪnáʌɐ	10 cɪvɪtŏvɒhɒɔ	10 télɐn

705 *a.*	706.	707.	708.	709.
(*Lenàpe.**)	*Chippeway.*	*Penobscot.*	(*Passamaquoddy.*)‡	*Potewàtemi.*
ngutti	1 pɛʒɪ'G, bɛʒɪG	1 pèsɐc	1 nɛ́cɐt	1 ngo·t
nischa	2 nɪ˛ɟ	2 nɪɾ	2 tàbʊ	2 nɪ·ɾ
nacha	3 nɪsvɪ'	3 nāhs	3 sɪs	3 nsvɛ
newo	4 nɪvɪ'n	4 jèʊh	4 nɛ́ŏ	4 nɟè·ŏ
palenach	5 nā˛nɐ˛'n	5 pălènɐscʊ	5 nʌn	5 nɾà·nɐn
guttasch	6 ɪſGŏdvʌsvɪ'	6 nɛc"vdɐ's	6 ca·màts	6 nGŏtvà·tsŏ
nischasch	7 nɪ˛ɟvʌsvɪ'†	7 tɐmbà˛v˛ɐs	7 ɛ́lŏìGɐ˘nɐc	7 nŏvɐ'c
chasch	8 nɪɾvʌsvɪ'†	8 ṇsā˛sɐc	8 ŏGmɐ'ltɾɛ	8 svà·tso
peschkonk	9 ɾŏ'vGɐsvɪ', ɾŏſ	9 nōlɪví	9 ɛscvŏnàdɛc	9 ɾàcă
tellen	10 mɪtāsvɪ'	10 mdālá	10 tɛ́lɐn	10 mɐtà·tsŏ.

* This is Zeisberger's version, taken in Pennsylvania in the last century; ours is from a resident of Texas. Zeisberger did not recognise the vowels of *up, at,* like those who first wrote English (§ 585, 587,) and when the Delawares have their men of letters, these may imitate the English orthoepists, by assuming that Zeisberger's spelling was strictly phonetic, and that it ought to influence modern speech.

† This resemblance is unusual. Baraga gives *seven* in Chippeway as *nijwasswi,* and *eight* as *nishwasswi.* Keating, in Long's Expedition, 1824, (whose vowels we transliterate,) gives seven ninjuassoe, (he knew the French nasals, so that *n* represents our nasal sign,) and eight nishwassu. *Six* is formed on *one,* (Lenàpe, &c.,) *seven* on *two,* and *eight* on *three,* with perhaps *over* or *beyond,* in respect to *five.*

‡ Dictated by a Penobscot. In Sakewi or sauk, *one* is stated to be 'nɛkotɛ.'

710.	711.	712.	713.	714.
(*Shawanee.*)	*Kansa.*	(*Osage.**)	(*Eskimo.*†)	(*Cape Flattery.*§)
1 nì·cŏtɪ	1 miɛ́ĉtsɛ	1 mɪ̯ɾtɾ	1 artlɛ́c	1 tsăc▷oakᶜ
2 nì·svɪ	2 no·bá	2 nò·mbă	2 marlúc	2 ăcl̋
3 nʔvɪ	3 diɲ·blɪ	3 là·brɪ	3 pɪʃăsút	3 vē
4 niè·vɪ	4 tò·ᶜbă	4 tò·bă	4 sĭsɛmút	4 bōh
5 nià·lă̯nvɪ	5 sɲ̀·tu̯	5 sà·tă	5 t̯ɛtlɛmɛ́t	5 ɾʊts
6 nɪcŏtvɲ̀ʔvɪ	6 ɾápɛ̯	6 ɾà·pɛ	6 āfenɪc-marlúc (2)	6 tsɛ▷pacl̋
7 nisvà·ʔvɪ	7 pè·ŏmɛ	7 pĕ·ŏmpvò, ò·mpă	7 āfenɪc-pɪʃăsút (3)	7 ácl̋pă̯
8 nʔvɲ̀·sɪcʔvɪ	8 pe·à·blɪ	8 cì·ăto·bă	8 āfenɪc-sĭɛmút (4)	8 ăclɛ́sɛb
9 tɾa·cà·tʔvɪ	9 ɾɲ̀cɛ	9 cɛre·brɛtɾɛʃcɪɛ	9 cōlīālút	9 ɛacŏăsɛb**
10 mɛtà·ʔvɪ.	10 cɛdè·blɛ.	10 cɛre·brɛ.	10 cōlìt.	10 kla▷ọ.

715.	716.	717.	718.	719.
(*Apàchɛ.*§)	(*Ipai.*§)	(*Yuma.*§)	(*Chinook.*‖)	*Chinese.*¶
1 tá̯hlɛ	1 sɪn	1 sɛ́ntɪc	1 tĉt	1 ɟɛtʾ (§564)
2 dacɪ	2 hăvɛ'qᶜ	2 ▷avɪc	2 mă·vcst	2 ɟɪ
3 t̯hĕ	3 χămóqᶜ	3 ▷ămóq	3 qḷ̥-q̣lōn (§551.)	3 sʌ·m
4 tɪ	4 tɾpɲp	4 tɾɛ́ʊmpàpqᶜ	4 lx⌣cɛt (ɹ?)	4 sɪ·
5 àstlă̯	5 sɛɾɲ̀p	5 să·ɾàptᶜ	5 qḷ̥-q̣ɪ·nɛm	5 ʃ
6 kɛ'stən	6 ▷ămăhòqᶜ	6 ▷ŏmɛ▷òqᶜ	6 tʊ̀ĉɛm	6 lɛcʾ
7 kɛ'stsɪdɪ	7 pă̯kàj	7 pà▷cĭɛ́qᶜ	7 sɪ'nɛmmăvcst(5,2)	7 tsʌ⌣tʾ
8 sa̯pì	8 tɾpōqᶜ	8 sĭpòqᶜ	8 stōĉtcɪn	8 pʌtʾ
9 gŏstàj	9 nɪmχămòqᶜ	9 ▷ámpămòqᶜ	9 cvàjɪts	9 cʌ·v
10 kɛnìsna̯.‡	10 ɾă▷òqᶜ.	10 să▷òqᶜ.	10 tʊ̀'ĉlĭlɛm.	10 ɔɛpʾ §490.

* Properly vɛsàɾɛ, here *nine* means ten-less-one, tɾ being a contraction of *one*, and ɪʃcɪɛ=*less*. So in the Mpòʃɢvē of West Africa, (as we have been informed by a French traveller,) *ten* is ìɢʊm, and *nine* is ɪnò̯ɢʊm= *not ten*. ** An accented *c*.

† Of Smith's Sound; dictated by Dr. Hayes, of Kane's Expedition. These differ somewhat from those given in Sir John Richardson's "Arctic Searching Expedition."

‡ 11 tlatsɪɛ̀ta̯; 12 dákī-ɛ̀ta̯; 13 t̯hɛs-ɛ̀ta̯. ‖ Dictated by Dr. J. K. Townsend.

§ From the dictation of Dr. John L. Le Conte, who is more than usually accurate in observations of this kind.

¶ Of Canton (cvòɢ̯to̯·ɢ̯) the second in the dialect of Macao, where the abrupt *t* may not have been observed except in the one case. But in our notes, the breath is indicated as escaping in the word for six. In the Canton word for *four*, we marked the vowel as made with the jaw open and the lips close, which would indicate a kind of French *u* based on the vowel of *it*. In this notation we used a sign like ⌒ for *lips open*; ⌣ *lips close*; ⊔ *jaw open*; ⊓ *jaw close*; ⊻ lips closed and jaw open, &c.

720. *Chinese.*	721. *Malay.*†	722. (*Hawaian.*)	723. *Tonga.*‡	724. *Grebo.* (W. Africa.)
[1] JʌT	[1] sàtŭ	[1] ăcáhĭ	[1] tàhă	[1] dō
[2] JI	[2] dùvă	[2] ărùă	[2] ùa	[2] sn̩
[3] sʌ˘m	[3] fìgă	[3] ăcòrŭ	[3] tòlŭ	[3] tā̩
[4] sI·	[4] ámpăd	[4] ăhà	[4] fā	[4] hā̩
[5] m	[5] lìmă =	[5] ărìmă	[5] nìmă	[5] m, m̄m
[6] lɐc˂	[6] ánăm	[6] ăònŏ	[6] ònŏ	[6] mlɛ̩́dŏ (5, 1)
[7] tɾʌt˃	[7] fùJŭt	[7] ăòtŏ	[7] fìtŭ	[7] mlɜsð̩′ (5, 2)
[8] pʌt	[8] dĭlàpăn	[8] ăvò′rŭ	[8] ɛàlŭ	[8] béhĭ̩béhĭ̩ (4)
[9] cJʌ˘v	[9] sɜmbìlăm	[9] ăìɛă	[9] hìɛă	[9] sìĕdŏ
[10] sʌp.	[10] sáblăs.	[10] ūmī.	[10] hò⌒ŏfùlŭ.	[10] pū˘.

† From the dictation of a Hollander speaking the language.

‡ In Wallis I. the same, except [1] tàhĭ, [2] lùă; in Fŭtùnă, the same, except [1] tásĭ, [2] lùă, [5] lìmă, [9] ìɛă, [10] càŭɛ/əfùlŭ.

CORRECTIONS AND ADDITIONS.

§ 181*a*. In some languages, *pb*, *td*, *cg*, are used indifferently, and as we employ (' ') for sonant and surd, it may be necessary to have a *p*, *t*, *c*, *f*, or surmounted by (ˇ) to indicate this indifference. In Baraga's Otchipwe Dictionary, it is directed that words not found under *p*, *t*, *k*, are to be looked for under *b*, *d*, *g*, and the reverse.

§ 369, above ϵ Suab., 'ϵ Coptic' may be inserted.

§ 624, 12th word, the vowel after *l* is not nasal (as marked) but whispered.

§ 379, note. At Covent Garden Theatre we heard *pass*, *glass*, *man*, with the vowel of *fat* lengthened, and pâssed, flâunt, cân't. Mr. Kean, at the Princesses' Theatre, used the vowel of *fat* in *France*.

Whilst the foregoing pages show the extent to which the Latin and Greek alphabets may be used, they exhibit at the same time a number of undesirable forms, which may be avoided by selections from the various types (whether in use or rejected,) published in Mr. Isaac Pitman's Phonetic Journal, at Bath, England. The rejected letters amount to 110, of which about one-half are capitals. All of these are accessible in long primer, and most of them are in perfect harmony with the Roman alphabet. On the other hand, the letters of American origin are in the aggregate badly formed, and cut without taste or skill. The fact that our own illustrations have been taken from about *seventy* languages or dialects—of which a somewhat minute notation has been made—renders it obvious that the alphabet of any *single* language must require a much less complicated symbolisation.

ERRATA.

§ 52 l. 5 transpose *sh* and *sk*.

§ 167 note *c read* constructed.

§ 201 l. 4, for *cay* read *gay*.

§ 312 in the heading read § 237.

§ 681 in the Turkish word for *four*, omit ĭ, leaving its mark stand.

§ 669[1], for t' read t'.

P. 402, line 2, *omit* or.

ERRATA.

Page 182, line 19, for 53.3, read 55.3.
" 182, " 27, for 260, read 240.
" 182, " 34, for 1838–68, read 1838.68.
The other numbers in the same column are to be corrected in a similar manner.
Page 183, line 9, for Round, read Reversed.
" 183, " 10, after asimuths, insert 0.
" 183, " 13, for Round, read Reversed.
" 183, " 20, for 78, read 73.
" 183, " 27, for 21.1, read 12.1.
" 184, " 2, for Round, read Reversed.
" 184, " 20, for 36.9, read 38.9.
" 184, " 22, for deduct, read deduce.
" 185, " 12, for 5.25, read 52.5.
" 186, lines 11, 14, and 17, for Round, read Reversed.